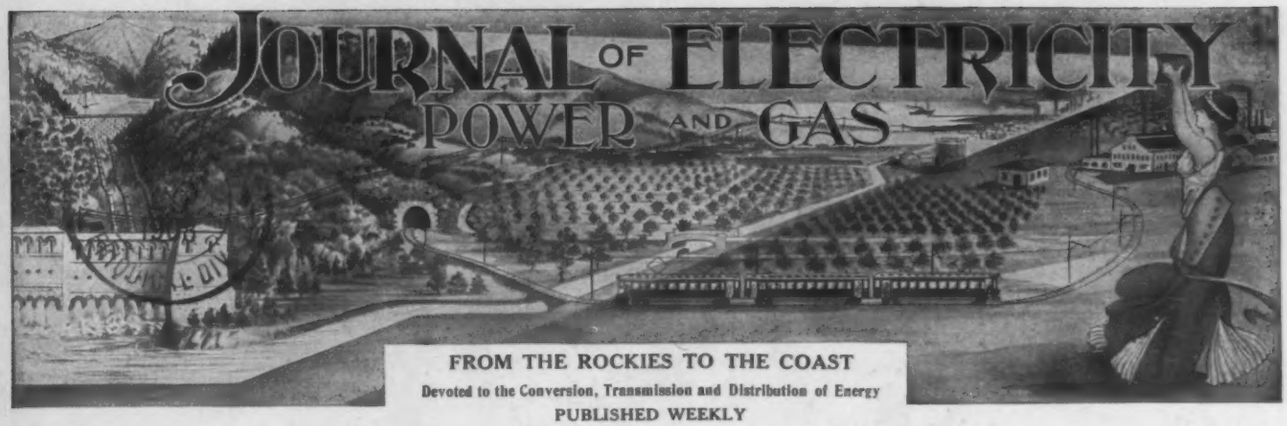
JOURNAL OF ELECTRICITY
POWER AND GAS
FROM THE ROCKIES TO THE COAST
Devoted to the Conversion, Transmission and Distribution of Energy
PUBLISHED WEEKLY

BY THE TECHNICAL PUBLISHING COMPANY, 111 NEW MONTGOMERY STREET, SAN FRANCISCO, CAL.
Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress Marh 3, 1879.

VOL. XXI. No. 4. SAN FRANCISCO, CAL., JULY 25, 1908. Yearly subscription $2.50. Single copies 10 cents. Back numbers prior to current month 25 cents.

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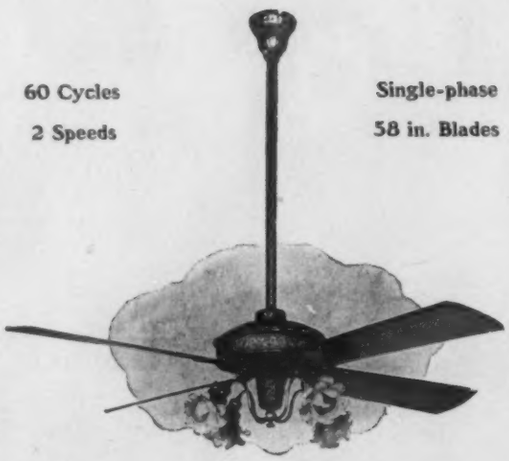

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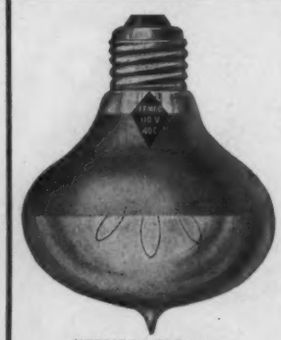

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Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

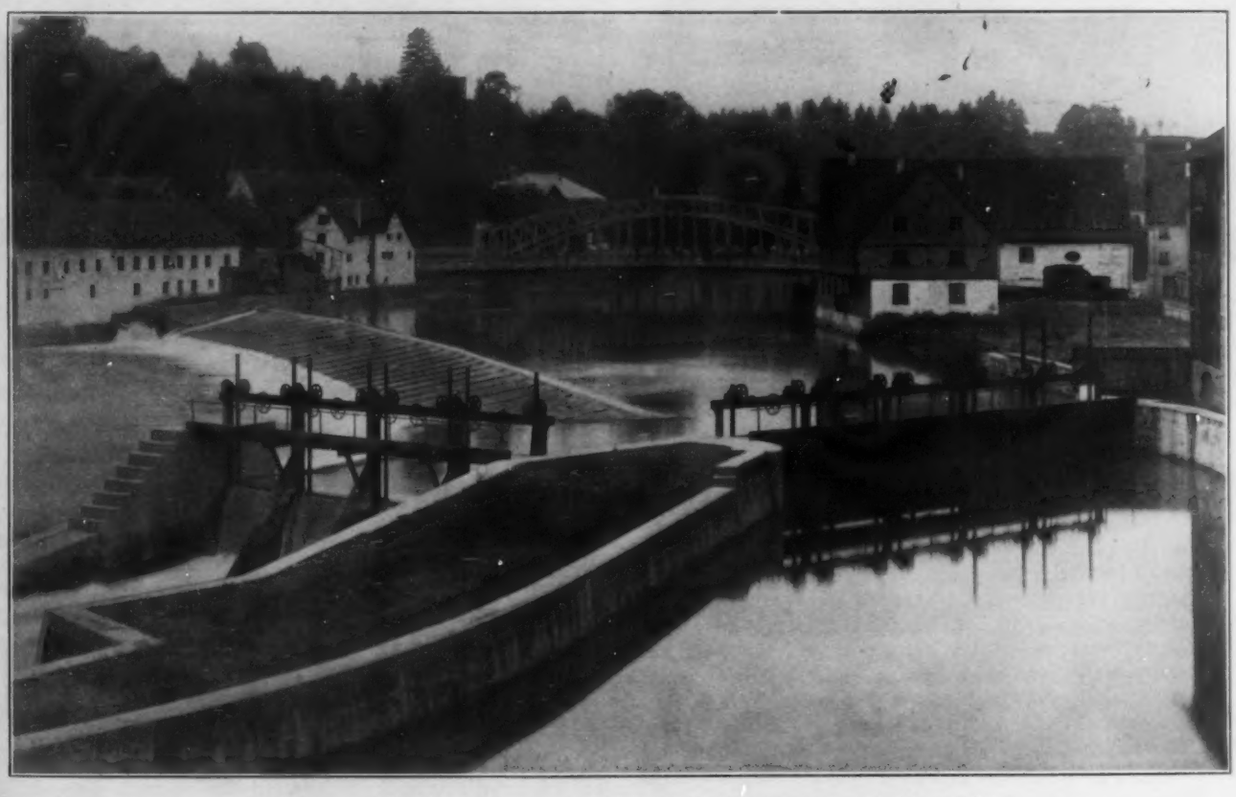
VOLUME XXI. SAN FRANCISCO, CAL., JULY 25, 1908 No. 4

The Kempten, Interlaken and Schaffhausen Bevel-Geared Plants.

While it is a fact that turbines and water wheels have been in use for many years for taking advantage of natural water powers, during the past two decades since the introduction of electrical transmission of energy, the development of the water turbine has been fully as rapid and satisfactory as that of the gas engine, steam engine, and steam turbine. It will be remembered that the earliest water-power plants were installed for operating flour mills, saw mills, foundries, and various shops, and little attention was paid to the efficiency or regulation of the water wheels and turbines, as slow-moving machinery was mostly driven.

The turbine, however, soon took the place of the under-shot, over-shot and breast water wheels as high-speed machines came into use for spinning and weaving, and also in machine shops, considerable attention being paid to the regulation of speed. The installation of hydro-electric plants made it necessary to design more highly-efficient turbines for driving electrical generators and automatic governors were required to maintain the speed as nearly constant as possible. For operating under high heads and with small quantities of water the impulse water wheel has been utilized with marked success, being superior to the reaction turbine for this purpose, the latter being best adapted to lower pressures and heads.

It may be of interest to consider the development of the vertical-shaft reaction turbine for use in hydro-electric plants, the first of which were employed with belt-driven electrical generators, while later the dynamos were operated by bevel gearing from the turbines, and finally, in order to avoid excessive and unnecessary heavy frictional losses or power, and to obtain the simplest and most rational installation, the turbines and alternators of the direct-connected vertical-shaft type were developed. The accompanying illustrations, Figs. 1 and 2, and drawing, Fig. 3, show the exterior and interior of the Stadtisches Electrizitatswerk Kempten, where bevel gears are used for the power transmission from turbines to the electrical generators, working under a head of 1.8 meters, the turbines operating at 40.8 revolutions per minute.



THE ILLER RIVER SUPPLYING WATER TO KEMPTEN HYDRO-ELECTRIC PLANT.

The Kempten hydro-electric central station was equipped with these vertical turbines driving through bevel gearing, the horizontal-shaft electrical generators at a speed of 150 revolutions per minute. Two Francis turbines were ultilized in this power plant having a combined capacity of five hundred four horsepower.

It may be stated that with the introduction of direct-connected vertical turbines and alternators later the common speed of revolution was increased as high as possible without decreasing the efficiency for economical reasons. It may be of interest to consider later some of the great installations with comparatively low head, and high-power units with direct-connected vertical shaft, turbines, and alternators, where relatively high speed or revolutions were attained by means of special forms of conical, centrifugal, and multiple turbines, as at Chevres, Switzerland; Lyons, France; and Rheinfelden. As it was necessary to keep the dynamo perfectly dry, they were placed high above

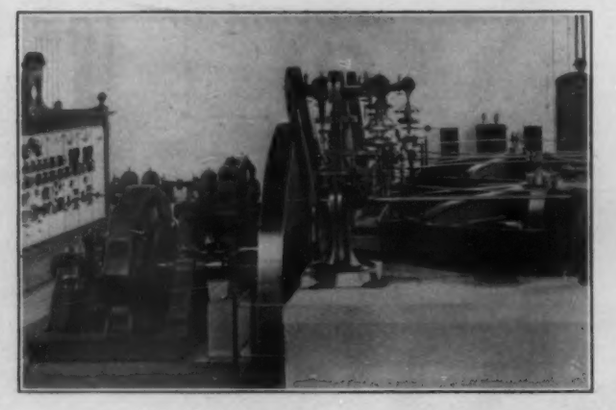


FIG. 2. TURBINE AND GENERATOR AT KEMPTEN HYDRO-ELECTRIC STATION.

the vertical turbine on an upper floor of the power house, the turbine being mounted below, the latest plants using a draft-tube in order to take advantage of the whole fall available.

At the Luterbach-Solothurn hydro-electric plant there is an extremely low fall of 1.8 meter. There are six turbines installed which were constructed by the Actien-Gesellschaft, formerly Joh. Jacob Rieter & Co., of Winterthur, each having a capacity of one hundred sixteen horsepower and operating at a speed of thirty revolutions per minute.

These turbines each take eight thousand six hundred sixty liters of water, and they drive the electrical generators by belt transmission. The electrical machines include five alternators and one direct-current dynamo, constructed by Brown, Boveri & Co., of Baden, Switzerland. This plant was installed and operated by the Aare-Emme-Kanal-Gesellschaft, of Solothurn.

A bevel-geared hydro-electric plant was installed at Interlaken. This station was equipped with three revolving-field alternators with horizontal shafts operating at a speed of 200 revolutions per minute and delivering a single-phase alternating current of sixty amperes at a pressure of two thousand volts, the frequency being fifty periods per second.

These three alternators were driven by bevel gearing from vertical turbines constructed by Theodor Bell and Cie, of Kriens, near Luzerne, Switzerland. The water was taken from the River Aaare, the canal construction being placed by Baumeister Frutiger, of Oberhafen. In the power house there were also installed two direct-current exciters operating at a speed of 750 revolutions per minute, each of two thousand watts capacity.

The primary transmission lines were constructed to Interlaken, Watten, and Unterseen, a single-phase current being used of two thousand volts on the primary circuit, the secondary distribution being arranged for a potential of one hundred five volts.

These towns were supplied with several thousand 16-candlepower lamps, as well as numerous arc lamps, while the power circuits supplied current to motors ranging in size up to twenty-four horsepower. The power transmission lines are from 600 meters to 3,790 meters in length, the loss

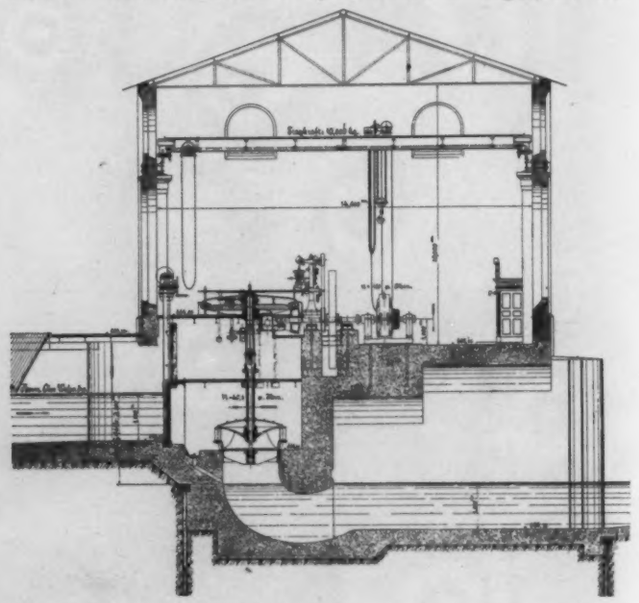


FIG. 3. BEND GEARING AT KEMPTEN HYDRO-ELECTRIC STATION.

on line being about five per cent. Concentric cables were utilized, and there were about forty oil step-down transformers of from three to fifteen kilowatts each. The power house was constructed about twenty meters long and eighteen meters wide. The turbines are of the Jonval vertical-shaft type and operated at a speed of sixty-two revolutions per minue, each having an output of one hundred eighty horsepower in addition to the three turbines driving the alternators through bevel gearing above mentioned there operating at 120 revolutions per minute. These turbines were arranged to be governed by hand as well as by means of automatic regulators.

One of the largest hydro-electric power stations in Europe using vertical turbines of high-power and low-head driving horizontal-shaft alternators through bevel gearing is the Wyanu-Langenthal installation. This plant was constructed by Siemens & Halske, of Berlin, and electrically equipped with five seven hundred fifty horsepower revolving-field alternators and two multipolar direct-current exciting dynamos of one hundred twenty horsepower each. The exciter turbines operate at a speed of ninety-six revolutions per minute, taking three thousand liters of water for each turbine when developing one hundred twenty horsepower.

These turbines, as well as five large turbines driving the alternators, were installed by Joh. Jacob Rieter & Co., of Winterthur, Switzerland. The alternators were driven by vertical turbines through heavy bevel gearing, the turbines having a speed of 41.5 revolutions per minute and developing 750 horsepower each at this speed. Each turbine used 18,800 liters of water working under a normal head of four meters.

THE REDUCTION OF IRON ORES BY ELECTRICITY.

Discussion by members of the San Francisco section of the American Institute of Electrical Engineers, of papers published in "Journal" of July 18, 1908. The following members participated in this discussion:

A. M. Hunt—Chairman.

C. F. Elwell—Noble Electric Steel Co.

H. W. Crozier—Sanderson & Porter (consulting engineers).

H. Homberger—Engineer, Doble Water Wheel Co.

Geo. J. Henry, Jr.—Engineer, Pelton Water Wheel Co.

Mr. Morgan—Sec., Noble Electric Steel Co.

The Chairman—I think we are under obligation to Mr. Elwell for this paper, and I am sure that we have all listened with interest to it. It is the one that gives us the first description of a branch of work which is bound to become very prominent on the Coast. While it is not usual for the presiding officer to start a discussion, I am going to see if we can start something out of Mr. Elwell. In examining the sketch of the Lyon-Clevenger furnace, which accompanies this paper, I note that there is shown a bussel pipe with what are apparently tuyere pipes entering the furnace above the crucible. No direct reference is made to this in the description of the furnace, although the remark is made that "it is found advantageous to burn a quantity of air on top of the charge." I would like to ask Mr. Elwell if air was regularly used in the furnace, and, if so, in what quantity referred to the amount necessary to consume the charcoal on the charge? Can you answer that?

Mr. Elwell—Well, that drawing was made before the changes that we have since introduced. We first used a bussel pipe to take the air through the top of the charge. This passed through a cooler that made it cool enough to handle. The tuyere pipes we have taken out. The air was taken to the top of the charge something on the line of the blast furnace. The temperature of the gas was so low that it was not high enough for the first reaction to take place, so we abandoned that and burned sufficient air on top to allow the gases coming up to burn, and therefore to keep the air and charcoal red hot at the top of the furnace. Of course, there must be some small consumption of charcoal, but by taking gas analyses, we keep that down to a minimum; we know how much CO and how much CO_2 we have, and figure out the consumption of charcoal to a minimum.

The Chairman—It is also stated that to date six runs have been made, varying in length from ninety to two hundred and seventy-nine hours. It would be very interesting to know just what limited the length of the runs. Was it due to operating troubles, or was it due to causes outside of the furnace? Perhaps Mr. Elwell will state.

Mr. Elwell—I have a copy of another paper which I wrote and which I did not read to you because it is full of data; but I think I can answer Mr. Hunt's questions better by reading from this a little of what happened on the various runs: (Reads.)

Run No. 1—This was in the nature of a preliminary run, for the electrodes were not bricked in above their top sides. This was done with a view of watching the behavior of the charge. The run was commenced on January 8th and lasted two days. The distance between the electrodes was determined by moving them in and out and after bricking up the side open to the air the furnace was started up once more.

Run No. 2—This was commenced on January 29th, at 7 a. m., and lasted until February 2nd, 7 a. m., or a period of ninety-six hours. The crucible failed by the slag getting out under the electrode. A total of 5,319 pounds of pig iron was obtained, but no electrical data was obtained, owing to non-arrival of the measuring instruments.

Run No. 3—The crucible was repaired, the electrodes still being left horizontal. The run was commenced at 10:30 a. m., February 10th, and lasted until February 14th, 1:30 a. m., or a period of ninety-nine hours.

The crucible failed by the slag getting by the electrode again. A total of 3,476 pounds of pig iron was obtained. The energy expended was .525 K. W. Yr. per ton of pig iron produced. This includes all energy from time current was switched on until switched off, and was measured with an integrating wattmeter. As the run was so short the energy used to warm up the crucible militates against a good figure being obtained.

The chief result of this run was to decide that the electrodes should be put in at an angle and that they should be efficiently water-cooled.

Metallurgical troubles were encountered on this run. A very pasty slag was formed and the crucible contained a quantity of calcium carbide when opened up. It was decided to try the basic lining once more.

Run No. 4—The crucible having been relined, the electrodes put in at an angle of twenty-five and thoroughly water-jacketed the current was switched on at 6 p. m. on February 26th, and the run lasted until 7:20 p. m., March 4th. The shut-down was quite voluntary, and was brought on by the fact that we had decided that after our experience with the basis slags, the acid lining and acid slag might be better.

As in the previous run, we had considerable difficulty with the charge, but in spite of these metallurgical troubles a figure of .376 K. W. Yr. was obtained for the whole period. The best day was March 4th, when a figure of .247 K. W. Yr. per ton was obtained.

Complete charging data is given for this run; also a graphical log.

Run No. 5—The crucible was lined with silica brick and the charge was computed to give an acid slag.

The current was put on at 10 a. m., April 2nd, and the run lasted until 11 p. m., April 10th, a period of 205 hours. A shut-down was caused this time by the breaking of a water pipe, which allowed water into the crucible, chilling the charge.

The best day's run was April 6th, when a figure of .243 K. W. Yr per ton was obtained. The average for the whole period was .37 K. W. Yr. per ton.

This run was characterized by bad metallurgical troubles and much scaffolding, due to a workman putting a lot of cold slag in as charge. The acid slag showed that it was very clean and fluid and much harder to keep in the crucible as shown by the number of runaways in which the whole slag bath was lost. This loss of the slag bath is a great set-back to an electric furnace, for it leaves the charge between the electrodes full of holes and therefore a very poor conductor. The voltage was raised and full energy put through the furnace until another slag bath was formed, when the smelting went along at a rapid rate. These set-backs make a very poor average of energy per ton, because of the energy used to smelt slag charge.

Determinations of the Si. content were made for every tap, and are plotted on the graphical log. The slag was analyzed for SiO_2 at frequent intervals. The slag obtained was weighed at intervals.

Run No. 6—The crucible was relined with fire-brick and calcined chromite was used as an inner lining up to the slag level and under the electrodes. Very shortly after the run commenced, it was evident that the chromite was not standing very well. The first iron contained as much as 9.6 per cent of Cr. and it continued to show Cr. until tap No. 41 when only .1 per cent was detected. As the weight of this

lining was known, an account of the way the lining was lasting was obtainable each day from a consideration of the weight and percentage of chromium in each tap of iron and slag. The refractory nature of the material caused a large amount of the energy put in to be expended on its reduction and hence the results do not appear as good as in previous runs.

The current was put on at 4:35 p. m., April 25th, and the furnace was voluntarily shut down at 7:05 a. m., May 7th. For two days before the shut-down, great difficulty was experienced in tapping the furnace. The electric arc was resorted to and showed the presence of a solid mass of iron on the bottom of the crucible. The furnace continued to take charge steadily, but it was difficult to get the iron out. The best day was May 5th, when 1.286 tons of iron were produced at the rate of .238 K. W. Yr. per ton.

This run was different from previous runs in that the stack was made air-tight, and the blower used to pump the CO_2 back through the charge. After several days' trial this was abandoned, as the temperature in the stack was not sufficient for even the first reaction to take place. Pipes were put through the sides of the stack at intervals and a variable quantity of air was admitted, so as to burn the CO_2 to CO on top of the charge. This pre-heated the charge so that the reactions would take place on its way down the stack. Beneficial results were noted very soon after.

The Chairman—That gives a very clear answer, and shows, as far as one can tell, that the difficulties were in no way a question of electrical operation, but minor troubles and results that are very apt to appear when very high temperatures are used.

Mr. Elwell, in discussing the question of refractory brick for crucible lining, notes fireclay, silica, magnesia, and bauxite as the materials at our disposal, and calls attention to the fact that even their melting points are not entirely satisfactory in protecting them against the highly-localized heat of the electric furnace. Some years ago a refractory brick was offered for sale by the Acheson people, made of an electric furnace product. It was, as I recall, a by-product of the carborundum manufacture, being the envelope immediately around the core of the crystalline carborundum. It was first called "Siloxicon," but I understand that the name was afterwards changed. It has always appealed to me that this material could be used for a furnace lining with good results.

In this connection, I would note that quite an extended series of runs were made with an experimental electric furnace for smelting iron, by Messrs. Greene and MacGregor, at the Boston Institute of Technology, in 1907. Among other things, they endeavored to get at the temperature of the bath of metals in the crucible. They finally succeeded in getting some very concordant results, using a Wanner Optical Pyrometer. To obtain the temperature of the molten metal, a carbon tube having an internal diameter of one inch, and closed at one end, was placed horizontally through the furnace wall. This closed end formed a part of the base of the crucible itself. With this arrangement, the molten metal was in direct contact with the surface upon which the pyrometer was focussed. Runs were made at temperatures varying from 1393 to 1922 degrees Centigrade. Considerable data were obtained as to the effect of variation of temperature on product and furnace action, but not sufficient to justify any broad generalization. As might have been expected, the amount of iron lost in the slag increased with temperature.

The power factor of this furnace averaged about ninety-two per cent.

The energy consumption was high, the furnace being quite small, absorbing from 15 to 25 kilowatts as conditions were varied.

It is well recognized, in electro-thermal applications, that the function of the electric current should be restricted as far as possible to the sole uses in which it is indispensable or for which it is clearly superior to the use of other kinds of energy. The process which I shall now describe is one in which this principle is carried out.

In 1902, and again in 1903, papers were read and discussed before the American Electrochemical Society by Marcus Ruthenberg, of Lockport, N. Y., describing experimental work that was being carried out in reducing iron directly from magnetic ores by a process in which electricity played an important part. The process seemed to me at the time to be peculiarly adaptable to our California conditions, and shortly after reading the above papers, I came in contact with a gentleman who had met and talked with Mr. Ruthenberg, and who had several pounds of the product of his furnace.

The apparatus used consisted essentially of a pair of slowly-revolving electrodes, similar to a pair of rolls, mounted over a slot in the roof of a furnace or soaking pit, built of refractory brick. The electrodes are hollow and within them are introduced the poles of an electro-magnet, giving a strong magnetic field between the two electrodes. The following quotation from the author's discussion will explain the action:

"In the first place, I ought to explain the action of the furnace. I remarked a while ago that it was only suitable for the use of magnetic ores; and the reason is that the smelting is done in a magnetic field, and the magnetic field plays no other part in the smelting operation than holding the ore until it is melted into lumps, or until its dusty form has been broken up, so that it will no longer pack and impede the flow of gas. The poles of the magnet are surrounded by a pair of water-cooled, carbon-covered cylinders. The carbon plays no other part than, should the furnace flash, it prevents the iron oxide from being welded to the rolls. The carbon covers do not get hot; the rolls are kept partially filled with water, which is continually fed in like a water-jacket and overflows; and as the rolls slowly revolve around the magnetic poles, the moment that the particles of iron ore that have been held as a bridge are molten, they drop out from weight or from loss of magnetic permeability. These molten particles drop into the soaking pit, and in dropping, if the top of the charge of the pit is close enough to the rolls, part welds to part; but it makes a friable, permeable, granular mass that is freely permeated by the gases by which reduction is accomplished. An analysis from a sample taken immediately upon dropping from the rolls will show anywhere from two to five per cent more iron than raw ore that went in; showing that some oxygen may be eliminated while between the rolls. What reaction that would be due to I am unprepared to say. It goes into the pit with not over five per cent elimination of oxygen, and the balance of the oxygen is removed in the pit through action of hot CO."

Again, quoting from the author's discussion:

"As far as the analysis of the iron is concerned, I have had results varying from only five to ten per cent reduction up to as high as ninety-two per cent; the product of the soaking pit would come out ninety-two per cent metallic iron, which I have considered fairly good work up to the present time.

"Three problems have presented themselves for solution, in the conduct of my work: First, the power required to agglomerate, and sufficient heat for subsequent reduction; second, the regulation of the size of the agglomerated particles; and, third, the amount of reduction of the agglomerated material.

"The status of these three problems to-day is that a ton of ore is being agglomerated with an expenditure of about 250 K. W. H. The size of the product is under perfect control. The reduction is being made absolute. Inasmuch as the only function of the electric current is to agglomerate the dusty particles into coherent masses without

binder or flux, and to convey a sufficient quantity of heat to the ore in the soaking pit, to permit the reducing agents to perform their functions, it will be readily comprehended that the heat and current losses due to maintaining a molten mass are lacking."

I have quoted quite at length to give both the author's claims as to what he has accomplished, as well as the rationale of the process. I have no personal knowledge of the results obtained, but have examined some of the product. The sample which was shown me consisted of irregular particles similar in shape and size to what is termed granulated zinc, which is probably familiar to most of you. The particles were loosely coherent, and contained a considerable percentage of metallic iron. From examination, I believe it would make a very desirable charge for an open hearth steel furnace, when mixed with sufficient pig to reduce the remaining oxide of iron.

I have seen no references to this process for several years, and why it has not been exploited I am at a loss to know, as it certainly offers a solution to the problem of handling our magnetic ores, if the author's claims are capable of substantiation.

In this connection, I again quote from the discussion of this paper by Mr. Cowles, one of the pioneer workers in electro-metallurgy, who utilized the electric furnace in the later eighties for producing ferro-aluminum and other alloys. His statements are certainly entitled to a large measure of credence:

"I have had the pleasure of witnessing Mr. Ruthenburg's furnace and watching its operations. I have also measured its consumption of energy. One thing that impresses me as very favorable to it is the fact that the only product that drops into his soaking pit is the iron oxide after it is fused. Before it is fused it is magnetic and is held in the magnetic bridge of the furnace, and only such particles as become fused become non-magnetic and drop; so it is that he is continually charging into his soaking pit, iron oxide that has been heated hot enough to have fused. After this has accumulated in his soaking pit it furnishes a heated mass practically within a retort or chamber through which he can pass his reducing gases. Early in the seventies, Sir William Siemens and Sir Lowthian Bell experimented upon the reduction of iron oxide with hydrocarbon gases and carbon monoxide, and it was found that these gases caused a reduction of iron oxide to take place at very low temperatures; but, of course, the higher the temperature the more rapidly the reduction goes on. It was found impracticable to pass heat through the walls of the confining chamber and effect the reduction in this manner. In the case of Mr. Ruthenburg's furnace he is in effect, applying his heat or energy within his retort, and he does not have to pass it through the walls of a chamber that are bad conductors for heat. His ore drops into his soaking pit highly heated and in a condition to be easily permeable by gases. A moderate application of heat externally will eliminate radiation from his problem and then, by the passage of heated hydro-carbon gases through his charge, he contemplates securing complete reduction of the magnetic ores he is working with. It seems to me that one may look for his process to develop into a successful commercial process, especially in locations where water-power is cheap and coke is expensive. Carbon monoxide comes off from the top of the soaking pit. This gas can be carried around the sides of his soaking pit and be burned, and thus contribute largely towards preventing loss of heat from within by conduction and radiation. I should judge that the material that drops into his pit is heated to about 1,200 or 1,300 degrees Centigrade. Last night I made a calculation of the heat energy required for reducing magnetite. Mr. Ruthenburg states that by his process he can agglomerate a ton of pulverized magnetite with an expenditure of about 250 kilowatt hours. I have seen him do this with a much less expenditure of power. This statement is equivalent to saying that one electric horsepower hour will agglomerate six pounds, or 2,718 grams of pulverized magnetite, or Fe_3O_4.

"One electric horsepower hour is equivalent to 644,000 small calories. Assuming no loss in heat energy, this heat is delivered in Mr. Ruthenburg's furnace to 2,718 grams of Fe_3O_4, according to his statement, or 644,000÷2,718=237 calories delivered to each gram. The specific heat of magnetite is 0.154, or two-thirteenths that of water. Hence, if to each gram of magnetite there is given enough heat to raise one gram of water 237 degrees Centigrade, it would raise each gram of his magnetite 6.5 times 237 degrees, equalling 1,540 degrees Centigrade. This is under the assumption that the specific heat of Fe_3O_4 does not alter at high temperatures. In three gram-molecules of Fe_3O_4 there are 696 grams. Hence, according to Mr. Ruthenburg's statement, he is delivering to each three gram-molecules, 237×698=165,426 calories.

"This latter figure may be compared to that theoretically required in the reduction of three molecules of magnetite by methane or marsh gas (the most common hydrocarbon), under either of two assumptions; first, that the products of the reaction come off as carbonic acid and steam, or secondly, that they come off as carbon monoxide and steam.

"Taking the first assumption, the reaction would be

$$3\,Fe_3O_4+4CH_4+4O=9Fe+4CO_2+8H_2O$$

The heat required to dissociate Fe_3O_4 270,800×3=812,400 calories.

The heat required to dissociate CH_4 18,900×4= 75,600 calories.

Total heat absorbed, 888,000 calories.

Heat evolved by 4 molecules of CO_2 96,900×4=387,600 calories.

Heat evolved by formation of 8 molecules of H_2O as steam, 58,300×8=466,400 calories.

854,000 calories.

"The difference between the heat absorbed and the heat evolved, or that required for the reaction

888,000—854,000=34,000 calories.

"It will be noted that this is less heat energy than that which Mr. Ruthenburg claims to be delivering into his soaking pit. If we make the same calculation under the second assumption, which involves his oxygen passing off in CO, then the reaction would require 305,600 calories, nearly twice as much energy as Mr. Ruthenburg claims to deliver in his soaking pit.

"Mr. Ruthenburg contemplates pre-heating his reducing gases before their passage through his soaking pit, and while the electric energy is probably not sufficient to reduce the full amount of material that he agglomerates, there is available to his process, the heat that will be carried into his soaking pit by his heated reducing gases. Those who have criticized his process may not have fully understood this latter phase of the same."

If this process were operated in California, the gas necessary for the reduction of the iron oxide in the soaking pit could be produced from crude petroleum. I have made a calculation of the amount of oil necessary to produce the amount of gas required to reduce one ton of metallic iron, and the amount is approximately one and one-third barrels. I have assumed that the gas will be made by the process used in producing illuminating gas, whereas an unfixed gas could undoubtedly be used as it comes from the generator, with the use of a smaller quantity of oil.

If the Ruthenburg process will accomplish what is claimed for it, it should operate advantageously in connection with the process described by Mr. Elwell. The first produces a material of the character of low carbon steel containing an admixture of oxide of iron. The second produces a cast iron. Suitable admixture of the two would

make a desirable charge for an open hearth furnace producing steel with any required carbon content, and crude petroleum, properly handled, would furnish an ideal fuel for the open hearth furnace.

Mr. Elwell has failed to mention in his paper a recent type of electric furnace which is attracting very favorable attention from electro-metallurgists, namely, the induction furnace. It is not at all unlikely that it can be adapted for use in treating iron ores.

Mr. Crozier has looked up some of the published data concerning this type of furnace, which he will present to us.

H. W. Crozier—A type of resistance furnace, called the reduction furnace, was patented independently by Colby, Ferranti, and Kjellen, and consists of an annular, or helical, channel, in a refractory base, filled with a conducting or semi-conducting medium, which constitutes the furnace charge, and has a heavy current induced in it by a surrounding coil of many turns, carrying an alternating current.

The device, in point of fact, acts as a closed-circuit secondary of a transformer, and is said to be admirably adapted for fusing such metals as platinum, which, if exposed to the atmosphere while hot, absorb oxygen or other gases in their mass, and lead subsequently to blow-holes or other imperfections in the casting. The Kjellen process has since been considerably developed, and is now applied to the smelting of iron ore and the manufacture of a special quality of crucible steel in Sweden.

The iron and steel plant at Gysinge, Sweden, is now producing steel of good quality. It is tough, and, when annealed, can be readily worked in the cold state.

Kjellen attributes the improved quality of the steel manufactured by his process to the almost complete absence of gaseous matter, especially hydrogen. The capacity of the latest Kjellen furnace is 1,880 Kg., and charged with raw materials in a cold state is capable of producing 1,500 tons of steel per annum. It is supplied with single-phase current from a generator driven by a 300-horsepower turbine.

Kjellen early recognized the fact that in operating steel furnaces on the resistance principle, using carbon electrodes, the molten metal absorbs impurities from the latter and also carbon monoxide gas is formed as a result of the combustion, and hinders the elimination of the gas from the steel itself. On the other hand, if carbon be dispensed with and the current be led direct to the metal under-treatment by metal electrodes, enormous copper leads are necessary and water-cooled contacts. Water-cooled iron contacts have been tried, but give much trouble, due to hysteresis and skin effect, and consequent loss of power.

The furnace used consists of an annular groove or hearth, built of refractory bricks, and closed in at the top by refractory covers, which are removable for charging purposes.

Centrally, within the ring is placed one limb of a rectangular iron laminated core, upon which is wound a coil, which constitutes the primary winding, the secondary in the shape of the contents of the annular hearth, having only one turn. Current is supplied at a pressure of 3,000 volts, and the transformation ratio is such that a current of about 30,000 amperes flows in the secondary. The first furnace was installed in 1900 and later furnaces up to date. The materials used are Dannemon pig iron and wrought iron, which are fed into the furnace along with steel scrap.

Kjellen states that no difficulties have been encountered in making special steels with nickel, tungsten, and chromium, and that the alloys are quite homogeneous. The cost of production principally depends on the efficiency of the furnace and the price of power.

It has been found with the furnace now in use that the losses are 87½ kilowatts, and with an input of 165 kilowatts, the effective power used is 77½ kilowatts to produce 4,100 Kgs. of steel in twenty-four hours. A larger water wheel is to be installed, when it is calculated that 6,000 Kgs. of steel ingots can be produced in twenty-four hours with 200 kilowatts.

Cost of the process, from figures obtained at this plant, indicates that 1,000 Kgs. require 1,320 horsepower hours, and the cost is $41.38 for 1,000 Kgs. The output is 4,100 Kgs. in twenty-four hours. The cost of the furnace is given at $4,000.

Mr. Crozier—I have only a few notes that I have obtained in regard to induction furnaces that have been used for manufacturing steel, and while they only make steel from iron, it is to a certain extent connected with this process.

Analysis of steel sample:

C	1.450
Si	.470
Mn	.490
P	.011
S	.010

That corresponds to carbon 1.45. It is a very high grade of steel. They also, in working with this same process, instead of using cold ores, use melted cast iron and they get a very much better result in converting cast iron into steel by this method. (Applause.)

The Chairman—Mr. Homburger, can you not help us out on this subject this evening? You ought to be familiar with it, I think.

Mr. Homburger—I have listened with much interest to the very able paper on the reduction of iron ores by electricity; as I am interested myself in this subject to some slight extent, I should like to make a few remarks.

I must say, however, that I have not followed up this matter for the last three years, and must apologize beforehand if some of my opinions are now obsolete on account of recent developments.

I will also say that I have been personally interested in the Keller process, as friends of mine in Germany control the rights of this process for that country, and are about to install a plant for the production of pig iron.

The report of the Canadian Commission which investigated, in 1904, the various processes at that time operating in Europe (mostly only with small-size furnaces for experimenting) is about the most complete piece of literature available on electric smelting, and I am referring to this report for detailed data, and also for a quotation I will give you later, the quotation being a general criterion of the commercial possibilities of reducing iron ore in electric furnace and of manufacturing pig iron by electricity.

I wish to say that it has to be borne in mind that the experiment made at Livet, France, before the Commission, must be modified as regards cost of labor and power, if compared with the cost statement which we have heard to-night. As, however, the cost of labor is very much higher here than in France, the total cost of pig iron production must necessarily be higher here if the Keller process is to be followed in the same way as it was carried out before the Canadian Commission.

After having read the report of the Canadian Commissioners, and after discussion of the matter with my friends in Germany, I came to the conclusion that the Keller process was at the time the most promising of all smelting processes for pig iron production.

I will say again, however, that recent developments might have influenced the relative values of the various processes, so that possibly to-day the Heroult process is more favorable.

I will also say that the Keller process and the Heroult process are competitive. I cannot quite understand the remark of the speaker that as a result of the Keller experiment, the Canadian Government voted $15,000 in the spring of 1906 for the Soo experiments, and engaged the services of Dr. Heroult for the same. And it is further stated that it was impossible to run the Soo furnace on a commercial scale.

With reference to the furnace which has been built by Dr. Heroult for Mr. H. H. Noble, and improved by Prof. D. A. Lyon and Mr. D. H. Clevenger, of Stanford University, I note that the lowest run in power was .35 K. W. Yr. per ton of pig. This does not seem to be anything wonderful comparing it with the figures mentioned in this paper, and especially with the .188 K. W. Yr. in the second experiment of Keller's. The Canadian report gives .226 H. P. Yr. or .168 K. W. Yr. as the power consumption in a conservative estimate made for the Keller process. This was in 1904, and is very much lower than the energy consumption of the Heroult-Lyon-Clevenger furnace. I hope that the 1,500 K. W. furnace, which is now being built, will bring the energy consumption down low enough so that it can compete with the Keller process in this particular detail, which, however, seems to me to be of prime importance.

There seems to be a certain lack of uniformity in the rating of furnaces. The Canadian report rating same by their capacity in tons, while this paper speaks of the kilowatts of each furnace. I would like to know what the ton capacity of the 160 K. W. and 1,500 K. W. furnace at Mr. Noble's plant would be.

The speaker has made the remark that it is certain that for the reduction of iron from ore, the electric furnace can successfully compete with the blast furnace only in special localities under conditions which are specially favorable to the electric process and unfavorable to the blast furnace. These conditions are essentially cheap electric power and scarcity of coal. I might modify this and say scarcity of fuel, because I do not see why it should not be possible to adapt fuel oil to smelting—I mean physically possible. As far as I know, there is no plant on record where liquid fuel is used for reducing iron ore.

I will read from the Canadian report that paragraph which gives the opinion of the Commission under what conditions electric pig iron production would be commercially feasible.

The following are two approximate costs, based upon the figures discussed. The first is the estimate of M. Keller, from the results of the second experiment; the second is my own estimate, after considering the question with respect to the results obtained both in the first and second experiments:

	M. Keller's Estimate, Based on Energy Consumed in Second Experiment.	My Estimate, Based on Results from Both Experiments.
1. Ore (Hematite 55% iron) 1.842 tons at $1.50 per ton	$ 2.76	$ 2.76
2. Coke 0.34 tons at $7.00 per ton	2.38	2.38
3. Consumption of Electrodes, $45 per ton (34 lbs. per ton of iron)	0.77	0.77
4. Lime, 300 lbs. at $2.00 per ton	0.30	400 lbs. 0.40
5. Labor at $1.50 per day	0.94	0.94
6. Electric energy 0.226 H. P. years at $10 per H. P. year	2.26	0.350 E.H.P. 3.50
7. Miscellaneous materials	0.40	0.40
8. Repairs and maintenance	0.20	0.20
9. General expenses	0.20	0.20
10. Amortization (machinery and buildings)	0.50	0.50
Total without royalty	$10.71	$12.05

If we now consider these costs in comparison with the blast furnace, we get the following:

Electric Smelting.		Blast Furnace.	
Ore	$2.76		$ 2.72
Coke, 0.34 ton	2.38	0.925 tons	6.40
Electrodes	0.77		nil
Lime, 400 lbs.	0.40	400 lbs.	0.40
Labor	0.94	American practice	0.42
Electric Energy	3.50		nil
Steam raising for blowing Engine	nil		0.10
Miscellaneous materials, repairs and maintenance, say	1.30		1.30
	$12.05		$11.34

The steam used for the blowing engines costs little, as it is raised entirely by waste gases from the blast furnace, and ten cents per ton of steel produced will probably cover it.

On the basis, therefore, of fuel at $7.00, electric energy at $10 per E. H. P. year, the cost of production is slightly in favor of the blast furnace, and even when taking M. Keller's figures of $10.71, when allowance is made for a reasonable royalty, there is little margin upon the side of the electric furnace. The labor for the blast furnace is taken on the best American practice, and it would probably be fairer to increase this figure; but even if taken on the basis of English practice, viz., $1.00 per ton, this only raises the total cost to $12.34 per ton of pig iron, which is practically equal to the cost of electric smelting. The labor costs of 42 cents per ton in American practice must not be taken as an average cost, as they are based on the assumption that wages average $1.50 per man per day, the figure taken for electric smelting. The labor costs, both in England and America, vary considerably; in the former, from 48 to 80 cents, and in the latter, from 41 to 80 cents, according to the arrangement of plant and the price of labor in the particular district. It will be seen from the above statements that economical electric smelting is simply a question of the relative prices of fuel and of electric energy. With very high-price fuel, owing to the large amount required—nearly three times that of the electric furnace—the blast furnace is placed at a disadvantage; and, on the other hand, with fuel at anything below $7.00 per ton, the electric furnace cannot hold its own. It must be borne in mind that for blast furnace purposes, a hard, mechanically strong coke must be employed, but for electric smelting small anthracite or other small coal or fine coke, provided it is fairly free from sulphur, could be used. Such small coal, anthracite or coke, could probably be obtained at half the price of coke suitable for blast furnaces, and in such cases the reducing agent for the electric furnace would make the cost per ton of pig iron $1.00 less. If anthracite collieries were anywhere near, large quantities of small anthracite might possibly be obtained at a very low figure. For the purpose of comparison, it has been necessary to consider the value of the fuel per ton as being the same in each case, but local conditions, such as a good supply of a cheap fuel which is useless for blast furnace work, but suitable for electric smelting, might so reduce the cost of production in the electric furnace as to enable it to compete successfully with the blast furnace. Provided charcoal could be obtained cheaply, it could probably be used if it were briquetted with the ore.

We have in this paper estimates covering this subject referring to Captain Stassano's process, to Heroult's process, and to the 1500-kilowatt furnace, which is now being built for Mr. Noble, and I shall take up the latter in detail in the following:

(*Continued on page 62.*)

ANNUAL CONVENTION OF THE NATIONAL CONTRACTORS.

G. M. SANBORN.

The eighth annual convention of the National Electrical Contractors' Association was held at Chicago, July 15th, 16th and 17th, with headquarters at the Auditorium Hotel.

The following programme was carried out

WEDNESDAY MORNING,
July 15.

10 o'clock—Open Session for Members and Guests.
Address of Welcome—President Electrical Contractors' Association of Illinois.
The Electrical Contractors' Opportunities in the Illuminating Field.—Mr. George Loring.
The Relations Between the Underwriters and the Contractor.—Mr. W. H. Merrill, Jr.

WEDNESDAY AFTERNOON,
July 15.

2 o'clock—Business Session, for Members only.

WEDNESDAY EVENING,
July 15.

7 o'clock—Banquet for Members and Gentlemen Guests, Gold Banquet Room, Auditorium Annex.
7 o'clock—Banquet for Ladies, Small Banquet Room, Auditorium Annex.
9 o'clock—Vaudeville Entertainment, Gold Banquet Room, Auditorium Annex, for Members and Guests, including Ladies.

THURSDAY MORNING,
July 16.

10 o'clock—Open Session for Members and Guests.
Illuminating Engineering—Mr. J. R. Cravath.
The Relations Between the Lighting Company and the Contractor—Mr. Alexander Dow.
The National Electrical Contractors' Association—Mr. Seth B. Witherbee.

THURSDAY AFTERNOON
July 16.

2 o'clock—Business Session, for Members only.
2:30 o'clock—Automobile Tour through the South Parks and Boulevards for the Ladies.
2:30 o'clock—Tallyho Ride for Gentlemen Guests to National League Ball Park, New York vs. Chicago Cubs. Tallyhos will bring guests back to Auditorium after game.

THURSDAY EVENING,
July 16.

7:30 o'clock—Business Session for Members only.
8 o'clock—Theatre Party for the Ladies, Studebaker Theatre, adjoining Auditorium; Attraction, "Top o' th' World."
9 o'clock—Rejuvenation of the Sons of Jove, in Convention Hall, Auditorium.

FRIDAY,
July 17.

All Day Outing via Steamship "Theodore Roosevelt," to Michigan City, for Members and Guests, including the Ladies.
9:45 o'clock—Steamer leaves Clark St. Bridge for Michigan City.
11:30 a. m.—Luncheon on Board Boat.
12:30 p. m.—Boat arrives at Michigan City.
On arrival at Michigan City, Members and Guests will proceed directly across Bridge at Dock to the Amusement Park, for Athletic Sports, as follows. Prizes will be awarded the winners.
Entries should be made on boat before arrival, with Warren Orne.
1:00 p. m.—100-yard race for the Ladies.
1:15 p. m.—200-yard race for Fat Men; must weigh 200 pounds or over, to be eligible.
1:30 p. m.—Potato Race, open to all.
1:45 p. m.—Swimming Race, open to all.
2:00 p. m.—Take Special Cars at Entrance to Park, for Base Ball Grounds.
2:30 p. m.—Base Ball Game, East vs. West.
Members desiring to play should sign with Captains before arrival at Michigan City.
Geo. W. Russell, Captain for East;
E. McCleary, Captain for West.
4:00 p. m.—Take Special Cars at Entrance to Ball Grounds, for Boat Landing.
4:30 p. m.—Boat leaves for Chicago.
5:30 p. m.—Luncheon on Boat.
7:00 p. m.—Home, Sweet Home.

At the session held on Thursday evening, it was decided to hold the next Annual Convention at Toledo, Ohio, on July 21st, 1909.

The following officers were elected for the ensuing year:

President, G. M. Sanborn, Indianapolis, Ind.; Treasurer, John R. Galloway, Washington, D. C.; Secretary, W. H. Morton, Utica, N. Y.

PUBLICATIONS RECEIVED.

"Reinforced Concrete: A Manual of Practice," by Ernest McCullough, is a book of simple instruction for the man doing the work. In the course of its 125 pages the author discusses beams, columns, and walls from a practical standpoint, giving working formulas, but omitting all mathematical derivations. The chapter on designs and costs explains the use of the straight-line formulas for stress and contains many good suggestions on cost figuring. The author's extensive personal experience in the work is shown by the excellent descriptions and diagrams of construction details. The library of any construction engineer is deficient without this book. It is published by Cement Era Publishing Company, Chicago, and costs $1.00.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CABINETS.

Wood or steel cabinets with or without gutters, lined with slate or steel. For panel-boards, switches or cut-outs. Approved May 19, 1908. Manufactured by

The Cleveland Switchboard Co., 430 Prospect Avenue, N. W. Cleveland, Ohio.

CONDUIT OUTLET BUSHINGS AND COUPLINGS.

"Shawmut" outlet bushing and "Chase" nipple, for rigid unlined conduit. Also Chase combination coupling for rigid and flexible steel conduits. Approved May 19, 1908. Manufactured by

Chase-Shawmut Co., Newburyport, Mass.

FIXTURES.

"Erickson" for show case and shop window use. Types for tubular lamps of standard and candelabra size. Approved May 28, 1908. Manufactured by

L. Erickson Electric Co., 82 Sudbury St., Boston, Mass.

FUSES, CARTRIDGE ENCLOSED.

"Bryant" Glass Tube Enclosed Fuses, 1 and 2 amperes, 250 volts. Cat. Nos. 348 and 284. Approved May 19, 1908, for rosettes and attachment plugs and for protection of instruments and pilot lights on switchboards. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

LAMP ADAPTERS.

Adapters for Edison base lamps in T. H. sockets and receptacles, Cat. No. 9357. Approved June 17, 1908. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

LAMPS, ARC.

"Solar" Therapeutic arc lamp. Horizontal carbons, adjustable rheostat mounted on lamp stand, 15 A., 125 V. Approved May 20, 1908. Manufactured by

Modern Medicine Co., Battle Creek, Mich.

MISCELLANEOUS.

Sheet metal borders for footlight sections for stage lighting; constructed of sheet steel and provided with approved receptacles and wiring and suitable guard for borders. Approved May 18, 1908, when installed in compliance with requirements of Rule 31-A-3, 4, National Electric Code. Manufactured by

Kansas City Scenic Company, 2331 Grand Ave, Kansas City, Mo.

RECEPTACLES, STANDARD.

"Fielding" Receptacles, for two-wire molding, Cat. Nos. 50,724, 50,726; for three-wire molding, Cat. Nos. 36,519; for use with condulets, Cat. Nos. 46,555, 47,696. Approved May 22, 1908. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

SOCKETS, WEATHERPROOF.

"Bryant." Bracket styles: Porcelain shell, Nos. 9,496 and 9,448; composition shell, Nos. 43,311, 43,312, 43,313, 43,314. Pendant styles: Porcelain shell, Nos. 9,366, and "Bragdon," 50,997. Composition shell, Nos. 60,666, 43,310, 42,686. Approved May 26, 1908. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

"P. & S." Weatherproof Sockets, 3A, 250V. Pendant style, porcelain shell, Cat. No. 116. Composition shell, Cat. Nos. 60,666 and 60,666A. Bracket style, porcelain shell, Cat. Nos. 0-116½ and 116½. Pendant style for festoon work, Cat. Nos. 418, 420 and 420A to F, inclusive. Approved June 17, 1908. Manufactured by

Pass & Seymour, Inc., Solway, N. Y.

SWITCHES, AUTOMATIC.

Relay No. 171-A. Magnet energized by 24V current controlled from telephone switchboard. Double break contacts to be connected in series with one 16 c. p. 110V lamp, used for lighting telephone booths. Relay and terminals mounted on a slate base and enclosed in a steel or asbestos lined wood box. Approved June 17, 1908. Manufactured by

Western Electric Co., 463 West St., New York, N. Y.

SWITCHES, KNIFE.

Porcelain Base Switches, Cat. No. 954, double pole, 15 A., 125 V.; Cat. No. 955, double pole, 15 A., 250 V.; Cat. No. 956, three pole, 15 A, 125-250 V. Approved May 28, 1908. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

SWITCHES, KNIFE.

Type A switches, all capacities, 250 volts, single, double and three pole, with or without extension for open link fuses. Approved May 18, 1908. Manufactured by

Walker Electric Co., Noble and 23d Sts., Philadelphia, Pa.

RECEPTACLES, FOR ATTACHMENT PLUGS.

"F A" Surface receptacle holder for use with "F A" postoffice floor or wall box or exposed rigid conduit, 6 A., 250 V. Approved June 10, 1908. Manufactured by

Frank Adams Electric Co., 904-914 Pine St., St. Louis, Mo.

RECEPTACLES, STANDARD.

"Bryant" brass shell wall sockets, key (50 C. P., 250 V.) and keyless (3 A., 250 V.), straight and angle base types. Cat. Nos. 9,184, 9,185, 50,717, slotted or closed base types, and 50,753 and 50,755. Wall Sockets mounted on K. W. link fuse, rosette base, 2 A., 125 V., cleat and concealed types. Cat. Nos. 50,729, 50,730, 50,732, and 50,733. Also all of the above types with shade holders attached. Approved June 11, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

RECEPTACLES, STANDARD.

Porcelain shell, keyless, 3 A., 250 V., cleat type, Cat. Nos. 28,794, 28,795, and 11,221. Concealed Type, Nos. 50,744, 50,717, and 49,355. Conduit Box, Nos. 9,397, 40,537, 49,354 and 9,514. Sign Receptacle, No. 46,627. Wall Sockets, brass shell, key, 50 C. P., keyless 3 A., 250 V. Concealed base, Nos. 9,184, 27,742, 29,404, 9,185, 27,743 and 29,405. Angle base, Nos. 50,753, 28,721, with slotted or clothed bases, and Nos. 29,406, 50,755, 28,722 and 29,407. Approved June 9, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

RHEOSTATS.

J. & H. Reducer for alternating currents. A choke coil for use with the arc lamp of moving-picture machine outfits, 110 or 220 volts. Coils of the air-cooled type without enclosing case. Provided with suitable brackets for mounting as required for air-cooled transformers on low-potential circuits. Approved June 9, 1908. Manufactured by

Jacobs & Harris, 744 W. Adams St., Chicago, Ill.

"National" current regulators and speed control rheostats for continuous duty service. These rheostats do not have either no-voltage or over-load release devices. Approved June 8, 1908. Manufactured by

National Rheostat Company, 115 Franklin St., Chicago, Ill.

ROSETTES, LINK FUSE.

2 A., 125 V., "P-K," Nos. 816, 810, 811, cleat and concealed types. "K-W," Nos. 870, 871, 950, 951, 1,176, 873. Approved June 8, 1908. Manufactured by

H. T. Paiste Company, 32d and Arch Sts., Philadelphia, Pa.

SOCKETS, WEATHERPROOF.

"Newgard," with vapor-proof globe. Approved June 10, 1908. Manufactured by

Henry Newgard & Co., 30 and 32 W. Monroe St., Chicago, Ill.

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President

E. M. SCRIBNER, Vice-Pres. and Gen'l Manager.

A. H. HALLORAN, Secy. and Managing Editor

Directors:

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot commence with back numbers.

Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XXI JULY 25, 1908 No. 4

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EDITORIAL.

THEORY AND PRACTICE.

Recognizing that reciprocity is better than rivalry, we write theory **and** practice, not theory **versus** practice. Success is to be had sooner by co-operation than by competition. Heretofore the same goal has been reached by different paths on different sides of the stream. Each has thought his trail the easiest. Mutual concessions will bridge this stream wherever the way is rough, and progress toward success will be more rapid. Without theory, practice would soon go wrong, but without practice, theory would soon stop going entirely. Unaided, neither can reach the full measure of success.

An absolute standard of comparison for success cannot be fixed. It can be reached in as many ways as there are lines of human endeavor. It is ordinarily defined as a favorable termination of anything attempted. Relatively it is maximum result with minimum effort. Many compounds made up of the same elements are themselves unlike because of different proportions and different conditions of growth. The chief element of success is happiness gained through useful work, combined with a pinch of that "divine discontent, ambition," which causes progressive action. Unlike the mushroom, a vigorous plant requires sunshine. So does success. The world is just recognizing that in its highest sense it is not $ucce$$ that is most to be desired. Perhaps the best definition is that human effort which has done most to advance the general welfare of mankind.

Through inheritance and education, every man acquires certain tools with which to carve out his career. Their usefulness depends upon the kind of work he does, and upon his skill in using them. Some men are getting good results from comparatively poor tools; others having excellent tools accomplish but little. They may be applying high-grade tools to low-grade work, "chopping wood with a razor," or they may not know how to use what they have. It is no worse to own a dull chisel or a broken saw than a dull brain or a broken body. The main requisite is to take the best possible care of the tools given and utilize them to the greatest advantage. Intelligent direction of manual work should be synonymous with the physical embodiment of mental effort. In other words, both practical and academic engineers have much to learn from each other.

PERSONAL.

David Donzel, Secretary of The Pelton Water Wheel Company, has returned to San Francisco after a two months' sojourn throughout the East. He reports the Francis turbines, built by his company and in the plant of the Black Hills Traction Company, as affording excellent satisfaction in the way of regulation and efficiency. Mr. Donzel brings home a large and varied collection of allegorical Indian blankets, secured in Colorado and Arizona.

THE HON. GIFFORD PINCHOT, CHIEF FORESTER.

Professor Gifford Pinchot, Chief Forester and Chairman of the National Executive Committee on the Conservation of Natural Resources, gave a short address to the members and invited guests of the Merchants' Exchange, San Francisco, Tuesday, July 21, 1908.

His remarks were confined chiefly to the great work the Forestry Commission had done and were doing, and emphasized the fact that we should all endeavor to look forward into the future, and endeavor to conserve Nature's great resources for the generations yet to come.

He urged the people of California, in particular, to bestir themselves at once and have laws enacted that will govern the use of natural resources under private ownership. It seemed to be the impression among a great many men who own large tracts of land, that they have a perfect right to use these resources as they see fit, destroying great bodies of timber and leaving the underbrush to be a fire menace to the surrounding country; polluting the streams with poisonous minerals from their factories; allowing one of Nature's most bounteous gifts, natural gas, to be wasted in the air, and millions of gallons of oil to be wasted, particularly so by selling it to foreign countries at a price so ridiculously low that in a few short years they will look back and wonder how they could have had so short-sighted a policy; robbing the mines of their great mineral wealth, by stripping the rich ore and leaving the lean hardly worth the cost of working.

These and many other reasons, Mr. Pinchot gave us as his object in urging legislation at once.

The question of the charges to be made against the hydro-electric power plants which are operating within the forest reserves, was very lightly touched upon, the only argument Mr. Pinchot used was that the United States Government should forever prevent the power companies from holding a monopoly on the powers contained in the streams of America. He seemed to think that the great Standard Oil monopoly would be dwarfed into insignificance as compared with this one.

Mr. Pinchot's genial personality and his earnest convictions have made him many friends on the Pacific Coast. At the close of the meeting he was accorded a very warm reception from the members present.

Senator Francis G. Newlands, of Nevada, also addressed the meeting on the subject of waterways. He gave a most interesting account of his work, and pointed out the close relationship between the forest and the streams.

DOSSERT CONNECTORS IN SOUTH AMERICA.

The Rio de Janeiro Tramway, Light & Power Company, Ltd., of Rio de Janeiro, Brazil, have received a large shipment of Dossert 2-way joints comprising 25 for 500,000 C. M. cable, 100 for 250,000 C. M. cable, 100 for 00 cable, and 50 for 0 cable, from Dossert & Company, 242-244 West 41st Street, New York City. The order was placed through the New York office of the Rio de Janeiro Tramway, Light & Power Company.

PICNIC OF ELECTRICAL TRADES.

The committee from the Contractors' Association being unable to arrange for transportation to and from El Campo, had to abandon the idea of picnicking there, and have now arranged for a picnic at Fernbrook Park, a beautiful spot in Niles Canyon. A special train will be run from the Oakland Mole to and from the picnic grounds on Saturday, August 8th.

Most of the jobbers, manufacturers' agents, and contractors have been interviewed, and they have all promised to close up shop on the day of the picnic, and do everything possible to make the affair a very enjoyable one. Tickets will be $1.25 for adults, and 50 cents for children. It is expected that nearly everyone will take a good lunch with them, and have a picnic in the full sense of the word. If, however, lunch is not taken, a good meal can be had on the grounds for 50 cents.

All married men will, of course, bring their wives and children. Mr. Unmarried Salesman will buy a ticket for Miss Stenographer, and she will furnish the lunch.

As there will be a great "get together" benefit derived by all who attend, it is hoped that everyone interested in the electrical trade will do all possible to boost the affair, to the end that it may be so successful that it may become an annual affair.

PERSONAL.

H. W. Beecher, of the engineering staff of Chas. C. Moore Co., engineers, is visiting the Northwest on his honeymoon trip.

Mr. T. E. Bibbins, of General Electric Co., and his family are away on a few weeks vacation.

M. D. Spencer, resident agent of the General Electric Company at Spokane, Wash., has been in San Francisco during the past week.

Mr. Louis Allis, President and Treasurer of the Mechanical Appliance Company, Milwaukee, Wis., with his son, passed through San Francisco on his way to Yellowstone Park, Wednesday, July 22nd. His visit to the Coast was entirely on "pleasure bent."

TRADE CATALOGUES.

Bulletin No. 105 from the Crocker-Wheeler Co., Ampere, N. J., is devoted to Polyphase Induction Motors, constant speed, large sizes. A number of excellent half-tones show the application to mill driving.

Crocker-Wheeler Co., Ampere, N. J., have issued bulletin No. 87, "Electric Motor Drive for All Kinds of Printing Machinery." The following selling agents for Crocker-Wheeler apparatus on the coast will be glad to quote prices: Kilbourne & Clark Co., 507 First Street South, Seattle, Wash.; Engineering & Maintenance Company, 195 Fremont Street, San Francisco, Cal; W. B. Palmer, 416 East Third Street, Los Angeles, Cal.

The Pelton Water Wheel Company are distributing a 20-page booklet descriptive of Standard Pelton Wheels and type "C" Motors. It is of convenient pocket size and contains tabulated data of the power of falling water under pressure, speeds of Standard Pelton Wheels, table showing the safe pressure under which riveted pipe may be operated, friction losses in riveted pipes of various diameters, and other data of interest to water power users. Requests for copies should be mailed to the Pelton Water Wheel Company, 3219 Harrison Street, San Francisco.

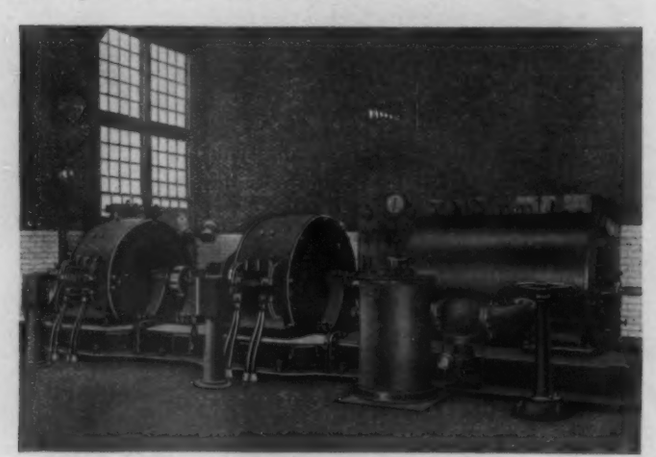
INDUSTRIAL

AN EXHAUST STEAM TURBINE PLANT.

An excellent example of the utilization of exhaust steam from prime movers by exhaust steam turbines, is that afforded by the Wisconsin Steel Company's mill at South Chicago. This installation, the first of its kind in America, is interesting from both the mechanical and electrical standpoint, and possesses many unique features of design.

The engine driving the Blooming mill is a double cylinder, reversible type common to rolling mill operation. This engine runs non-condensing, and under normal conditions develops a little over 1,000 horsepower.

The turbine, which is of the well known Rateau type, manufactured by the Western Electric Company, utilizes the exhaust steam from the reversible engine used to operate the Blooming mill. The steam, after passing through the receiver where the shock of the puffs of steam is removed, enters the accumulator or "regenerator," and from there passes to the turbine and condenser.



EXHAUST STEAM TURBINE.

The receiver tends to relieve the accumulator of the severe shock and strain which would result if the engine was allowed to exhaust directly into it. The receiver is provided with an exhaust valve to be used when there is more steam than necessary to meet the demands of the accumulator and turbine. In such a case the valve is opened to the atmosphere.

The accumulator or "regenerator" is, perhaps, as interesting as the turbine itself. It consists of a horizontal tank divided into two decks, each deck being fitted with a series of flues. This allows steam generated in the lower deck to pass up through these flues to the upper deck. This accumulator acts as a sort of a heat reservoir, absorbing or giving up energy as required by the turbine. The steam entering the accumulator at the bottom by means of a series of pipes, the ends of which are perforated, passes through the water in the accumulator. Part of this steam condenses, giving up heat to the water in the accumulator. As the accumulator operates at practically atmospheric pressure, we have when the engine is running, a large mass of water in the accumulator at 212 degrees Fahrenheit. Now, in case the engine stops, the supply of exhaust steam is cut off. If the turbine is loaded the steam, passing through it to the condenser, will tend to lower the pressure of the accumulator. As the water is at 212 degrees Fahrenheit, a temperature slightly above that corresponding to a decrease in pressure, this water will give off steam and act as a boiler operating at atmospheric pressure. This evaporation will cool the water so that when exhaust steam is again admitted to the accumulator the water will absorb heat. In case the supply of exhaust steam should by any reason be cut off from the accumulator for too long a period, live steam can be admitted by means of a reducing valve. The capacity of the accumulator is such, however, that the turbine will run seven minutes before this valve opens.

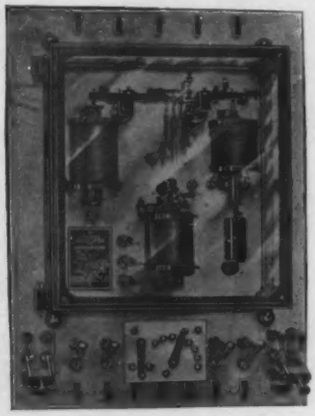
The turbine is of the Rateau type shown in Figure 1. In its design special attention was paid to mechanical strength because of the heavy, continuous duty to which these machines are subjected. Its wheels are turned from solid steel plates, and the buckets are of a non-rusting alloy, possessing great mechanical strength. Each bucket is riveted to the run of the wheel by specially designed rivets. By dividing the turbine into many stages the steam velocity within the wheel is very low. This prevents the impinging jets of entering steam from wearing the buckets. The speed of the turbine is regulated by a spring balanced fly-ball governor which operates a throttle valve located in the vertical cylinder seen in Figure 1. Owing to the low steam pressure this valve is unusually large. This arrangement gives a regulation especially good in spite of the sudden changes of load.

The dynamos, of which there are two, mounted on the same shaft as the turbine, were designed especially for this installation by the Western Electric Company, and possess some interesting features. These machines are each 250 kilowatt direct current generators, operating at 250 volts. The armatures are of the ordinary iron-clad type, but built much stronger. Due to the high peripheral velocity common to turbine driven sets, and the high co-efficient of expansion in long commutator bars, the diameter and length of the commutator is limited. To avoid any possible trouble the commutator was divided into two parts connected by means of tangs. The fields are of the usual type standard in direct current machines, commutating poles being used because of the high speed and large current. The armature is kept cool by means of fan blades attached to the armature, and to prevent noise, so common in high speed machines, the frames are enclosed in end bells. One of the strongest features of these machines is their over load capacity. For several hours at a time one of these has carried the entire load, while the other remained idle.

AUTOMATIC VOLTAGE REGULATORS.

The maintenance of a constant voltage at the lamp not only determines the economy with which a lighting system is operated, but is also essentially the measure by which the customer judges the excellence of the illumination supplied. The life and candle power of an incandescent lamp changes rapidly with comparatively small variations from normal voltage, and the automatic regulation of voltage at the station so as to give a constant voltage at the lamp is therefore of vital importance, and while apparently of benefit chiefly to the consumer, is, in fact, of far greater value to the producer.

In order that a practically constant voltage be maintained at the lamp, the generator should be controlled by a potential regulator so as to maintain a constant voltage at the bus or sub-station independent of load changes. The various feeders branching out from the station should also be controlled by feeder regulators arranged so as to automatically compensate for the drop in that particular feeder due to varying loads.

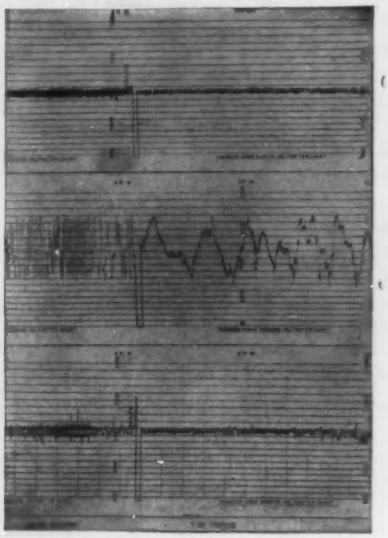


VOLTAGE REGULATOR MOUNTED ON MARBLE BASE.

By this system of voltage regulation a practically constant potential is maintained at the individual lamp with the following results: Decrease of lamp renewals, production of uniform illumination, increased sale of energy to the customer, decrease in number of station attendants, increased capacity of feeders.

AUTOMATICALLY OPERATED FEEDER REGULATOR.

It is possible to dispense with the regulator controlling the generator by supplying the individual feeders with regulators having a sufficient capacity not only to compensate for line drop, but also to compensate for the voltage variations in the generator. It is, however, advisable both on account of economy and operating conditions to control the generators by a Tirrill regulator. This regulator, shown in Fig. 1, is a relay device mounted on a switchboard, and is so adjusted that it controls the generator voltage by rapidly opening and closing a shunt circuit across the field rheostat of the exciter. The action of this regulator is very rapid, and there is practically no fluctuation in the voltage. By its



THOMPSON CURVE DRAWING VOLTMETER CHARTS, SHOWING REGULATION OF FEEDER VOLTAGE.

use, the kilowatt capacity of each regulator for the individual feeders is reduced as well as the number and amount of their adjustments.

Two types of regulators, designated as the BR and IR, are manufactured by the General Electric Company for automatically controlling the voltage of individual feeders. The feeder regulators of the above types are variable ratio transformers or rather compensators, having two separate and distinct windings, primary and secondary, connected

AUTOMATIC FEEDER REGULATOR.

respectively across, and in series with, the feeder to be controlled. The product of the volts and amperes on the generator or bus bar side is always equal to the product of the volts and amperes on the feeder side, less the small loss in the regulator itself. Both types of regulators perform the same function, and the principal difference in the results is in the rapidity with which they operate.

The BR regulator, shown in Fig. 2, consists essentially of a transformer, the secondary of which is divided into a

number of equal sections, and a dial switch, the points of which are connected to the sections of the secondary winding. In this type of regulator the moving element is exceedingly light, and having but little inertia, is particularly adapted for very rapid adjustments. The total time required for obtaining the complete range from maximum boost to maximum lower is about six seconds.

The BR regulator is built only for single-phase circuits and in comparatively small units, since the capacity is limited by the current and voltage, which can be conveniently handled by the switch. The capacity of the standard switch is 200 amperes, and 220 volts boost and lower. As this, however, represents a 20 per cent range on a 2,200 volt, 440 kilowatt circuit, and it is seldom found advisable to run a single feeder of so large a capacity, the standard BR regulator will be found suitable for the majority of conditions.

The induction or IR regulator, shown in Fig. 3, is more rigid, and substantial in construction, and has a less number of moving parts than the switch type and no moving contacts. The efficiency is somewhat higher, but it is slower in operation than the BR regulator, as the armature or movable core on which the primary is wound has not only considerable inertia, but also a torque depending on the kilowatt capacity, both of which must be overcome by the operating motor. The secondary or series winding is arranged in slots on the inside circumference of the stationary core, and the variation in the feeder voltage produced by the regulator is entirely due to the change in the angular position of the two cores.

The IR regulators can be furnished for operation on single or polyphase circuits, and are designated by the type letters IRS for the single-phase, IRQ for the quarter-phase, IRT for the three-phase, and IRH for the six-phase designs. Although used principally for the control of lighting circuits, induction regulators are equally well adapted to power circuits on which they have been used principally in connection with polyphase rotary converters.

The three curves shown in Fig. 4 were taken simultaneously, and show the comparative regulation of voltage by General Electric type BR and IR feeder regulators. The middle curve represents the generator voltage, while the upper curve was taken from a feeder controlled by a BR regulator, and the lower curve represents the voltage on a feeder controlled by a regulator of the IR type.

It will be noted that as long as the variations in the generator are gradual, such as occur on the ordinary lighting circuit, either type of regulator will produce a fairly uniform voltage, but with abrupt changes in the generator voltage such as are produced by a railway load, or in the starting of large induction motors, the switch type is the most satisfactory one.

THE REDUCTION OF IRON ORES BY ELECTRICITY.

(*Continued from page 55.*)

The iron ore in Stassano's estimate is rated at $3.60 per ton, in Heroult's at $1.50, and in the Shasta furnace at $1.75. What do those figures represent? One of the principal points for making electric smelting commercially feasible is to have the advantage of finding electric power available in large water powers in close proximity of the iron ore deposit, so that the furnace can be set up immediately in the ore fields and the electric power transmitted to the furnace. The accessories required for the charges are less than half the bulk of the ore required, and the total quantity of pig iron is in this estimate 66 per cent of the quantity of ore in the charge. I should therefore think that the smelting plant should be located close to the ore fields, which, I believe, is not the case with the Shasta smelter, and I should like to know the reasons for this.

Now, then, if an electric furnace is started by the owner of ore deposits at the site of his ore deposits, what represents the value of the ore? Leaving alone the question of shipping ore to the manufacturing plant, which would be well-nigh prohibitive in most cases, it seems to me that the value of the ore is limited by the cost of mining it. Is this $1.75 per ton at Shasta, or does this figure include anything else?

Electric energy I notice as being charged up at $5.00 per ton. This figure seems to me to be entirely too low, if you compare with it the value of electric energy in this part of the country in the general market, which varies all along from $50 to $100 per horsepower year, and I will say at this point that the retail price of power is not from fifty to one hundred times what it costs to generate. If this was a fact, some of the big power companies would be very happy indeed. Electric power plants utilizing water for their prime movers, and having long transmission lines to contend with, cost on an average from $100 to $200 per horsepower to install, and with the present progress of mechanical and electrical engineering, such plants are obsolete in ten years. Allowing therefor 10 per cent for depreciation, 6 per cent interest on bonds, including taxes, 5 per cent for maintenance and repairs, and 10 per cent for operating expenses, including the selling expense for the power, we arrive at a total of 31 per cent of the investment as annual charge, or $31 to $62 per horsepower against a selling price of $50 to $100 per horsepower year. Some of the gentlemen present who are connected with power companies and have to calculate the rates for current will probably find this 31 per cent entirely too low.

While I find the charge for current too low, I must say that the charge for labor seems to be entirely too high. If it takes ten men at the rate of $27 per day to produce fifteen tons of pig iron, it seems to me hopeless to compete with the pig iron produced in other countries where labor is cheap, and also to compete with blast furnace pig. In the Keller process the labor per ton is rated at 94 cents. Labor being on an average three times as high in this country as it is in France, we would arrive at about $3.00 per ton, but this was for a small experimenting plant, while the speaker's estimate is for a commercial plant. There is another point which I want to take up. The production cost in all of these statements is figured for the pig iron laid down at the plant. However, in order to sell it, it has first to be shipped to the point of consumption which in this case would be San Francisco. Taking the speaker's own figures of $16.14 cost per ton, we arrive, by adding $6.60 railway freight from Redding to San Francisco, at a price of $22.74 per ton, as compared with pig iron shipped here from Pittsburg, which can be laid down at $26.75 per ton, allowing $11.20 freight per long ton; and Scotch pig iron can be laid down in San Francisco for $18.82, including $4.00 duty and $2.87 for freight, and based on a quotation of 51 shillings in London, which is about the average. There is further the Chinese pig iron, which successfully competes in price and quality with the Scotch pig and therefore has to be taken into consideration.

As the speaker has not dwelled on the metallurgical side of the subject, I will refrain from making any remarks. However, in his conclusions he said under No. 6 that the quality of iron is very much better. I should like to know why. The samples I have seen so far did not look particularly attractive, and I have been unable to obtain any information as to the physical properties or a chemical analysis of the pig iron that has so far been produced by the improved Heroult furnace in Shasta County. I do not want to infer that I am skeptical. On the contrary, I should be very much pleased to learn that the electro-pig is actually better than the blast-furnace pig, because, as I stated in the beginning, I am personally slightly interested in the subject.

In concluding, the speaker also said that the original cost of the furnace was small. I should like to modify that, because the real future of the electric smelting I believe to be in localities where water power is available in proximity to iron ore deposits, and where there is no other market for the water power. Then, and only then, the energy cost can be put down at such a low figure as desirable for making the production cost of the pig low enough to stand high shipping charges. In this case, however, it is evident that the electric power plant will form part of the equipment and has to be added to the cost of the furnace, the same as the ore-handling machinery which will be required if the electric smelting plant is anywhere near the size which it should be to successfully compete with blast furnaces as they are used nowadays.

This also is at variance with the statement under (2) that the absence of bulky and costly charging machinery is an advantage of electric smelting. There was a time when all the pig iron produced was manufactured without any bulky and costly charging machinery, but that is a time of the past, and with the exception of a few charcoal iron plants in the backwoods of Sweden and Styria, there are no more pig iron manufacturing plants which can be built with a small investment of capital; and if the electric smelting is to become a process that will make its weight felt in the world's pig iron market, it must necessarily outgrow the size where the absence of machinery is an advantage. As coal is getting scarcer and scarcer as time goes on, without the demand for iron ceasing to increase at a rapid rate, the sooner humanity discontinues to use up enormous quantities of valuable fuel for the production of materials that can be obtained by utilizing the world's water powers, the better it will serve its own purposes, and I heartily join in the speaker's praise of Mr. H. H. Noble for having started this move on the Pacific Coast.

The Chairman—Has any one else any remarks to offer or any questions to ask?

Mr. Crozier—I would like to say about that question of freight in getting the pig iron down from Redding. I do not understand where Mr. Homburger gets that $6.00 per ton.

Mr. Homburger—From the Southern Pacific Company.

Mr. Crozier—The ordinary rate to Sacramento is only a dollar per ton and they have water transportation to Redding. I know they get to Redding with barges and I think they ought to make a rate of a dollar and a half at the very highest. All steamboats will take freight to Stockton and Sacramento at a dollar a ton. I am pretty sure they can handle barges. I know the smaller type go to Redding at certain stages of the river, and I am pretty sure they can handle pig iron at a dollar and a half to two dollars a ton. There is also the question of the comparison of cost of iron. I think all the speeches tonight have made the comparison between the cost of water power and the cost of fuel. Now, the cost of fuel does not come in in California. It is the present cost of pig iron, and I think in all the estimates that the cost of manufacturing the iron should be based on the cost of iron in San Francisco.

Mr. Henry—In regard to the cost of electric energy, if I understood him correctly, Mr. Elwell stated, I believe, that a quarter of a kilowatt per year, .25 per ton produced, was about the current charge. If that is true and if we can put in a hydraulic electric plant and fully equip it and deliver power to a smelter for a charge roughly of $30 per kilowatt per year—which I believe was Mr. Homburger's minimum—on a thousand kilowatt plant which would produce 4000 tons a year, and would give us, if we could sell pig iron at $20 per ton, a yearly income of $80,000. With a freight charge of $6000, or, say, $36,000 expenses outside of the smelter in order to market the product, and for which we would get $80,000, we would have a balance of $44,000 for the operation of the smelter per year, which, it seems to me, would carry a profit and a pretty big labor charge. In charging up a smelter at $10 per kilowatt, it is presumed, I imagine, in these figures, that that carries the cost of the electric plant, and that should not be added on a second time.

The Chairman—I would like to ask a question on the metallurgical side. Mr. Elwell made one statement that he put through some iron pyrites and got a result of .1.

Mr. Elwell—There are so many points that I would like to say something about, so first I will take Mr. Hunt's mention of the article called "Siloxicon." A company was formed in the East, and they were all ready to market it, but there was a hitch somewhere, and I asked Mr. Acheson about Siloxicon, and he said, "We are not manufacturing it any more."

The Chairman—If I may interject here, I think I know the reason why the Siloxicon Company did not proceed. Mr. Acheson got into a dispute with the Carborundum Company over the ownership of the patent under which it was to be manufactured, and a similar material is now being put on the market, called fire sand, by the Carborundum people.

Mr. Elwell—Speaking of fire sand, we have tried that, and at the present time the General Electric Company have a single-phase furnace lined with fire sand and soda silicate. That is all right for their furnace, but we cannot line our furnace with it, as it is too good a conductor. Fire sand is the outer coating or what is partially produced in the making of carborundum.

Mr. Crozier, in starting out, spoke of using the induction furnace to make steel from iron ore. I have heard of no case in which that has been done. Later, in speaking of his figures, he used the figure of 1320 kilowatt hours per ton of steel produced. I can give you the following figures in connection with this point. I distinctly said that it was of pig iron alone that I was speaking. I did not want to make mention of an induction furnace, because I wanted to bring in only the result of furnaces in California.

In connection with the induction furnace I will say a few things that Mr. Crozier did not bring out. On his question of 1320 kilowatt hours per ton of steel produced, I do not think that the figure is fair to the induction furnace.

In Germany they have a furnace now which they claim turns the pig iron into steel with 590 kilowatt hours. In Sweden they do take as high as 866 with a cold charge. In this country a furnace turns out only 90 pounds in a charge and leaves a hundred pounds. They say it only takes 550 kilowatt hours. So you see it takes not nearly the amount of power to turn cast iron into steel as to turn the ore into pig iron. Mr. Crozier did not mention one furnace with as large a capacity as five tons per day.

Now, coming to Mr. Homburger, I would like to say that my mention of the Keller furnace and the $15,000 was due to this fact, that when the commission went over to Europe they were shown some steel, but Heroult could not show them any pig iron. Then they saw the Keller experiment and were satisfied by that that it could be done. They had some negotiations with Keller. Evidently he could not come or Heroult got in ahead of him, and he came over and tackled the problem. The reports have been published in regard to those two experiments and full descriptions can be read of them. I take exception to the way they measured the power. If you look at their reports you find a reading, so many volts, and I think 5000 amperes from the beginning of the month to the end it is always 5000 amperes. That looks funny to me. Evidently they have selected something as an average and took the lowest they could get. They evidently had a wattmeter there because they took the power factor of the furnace at one time with a wattmeter, and they called that the power factor for good and all. Of course, they changed the furnace and more than likely shifted the bus. They assumed 91.9 per cent. Mr. Homburger dwelt on the point .188. He does not dwell on the other figure

.371. They were not able to verify either of these figures. They accepted them, and then the two were added together and the mean was taken and was thought to be reliable. This would make something over .26. In regard to the labor on the Heroult and Keller furnaces, of course we figured a fairly large amount for our labor. But there is this difference: We only need to figure on eight-hour shifts, three men, a foremen, and three men mixing the charge, and we pay them evidently a good rate of wage. We could build two and possibly three furnaces and those same men could look after all of them; that is, on the basis of 15-ton furnaces. Compare that with Heroult; he had to have a man on each winch; then they had electrodes which were held in by means of wedges; a man would have to get up on the edge of the furnace containing the seething mass with a sledge hammer and knock in the wedges; that called for three more men. The labor item on the Heroult furnace is no joke. That is for one furnace, and you can see what that is. We may take the 15-ton furnace and still not use any more labor. I notice the man has nothing much to do with the experimental furnace. Certainly, the men have little to do in charging one per day.

As to the cost of the top: I think it is cheaper to have a man shoveling than to have an expensive top. Later on we may have the whole thing done by machinery, with one foreman, and even tap it by machinery; at present we do not.

We figured on using a 150-kilowatt and that we would get a little over a ton a day, and that is what we got. Theoretical efficiency of electrical furnaces is not very reliable. We find that we have an efficiency of a hundred per cent, and Heroult and other people have an efficiency of about two hundred per cent, which shows that there is something wrong somewhere.

Mr. Homburger mentioned 34 pounds of electrode per ton. I wish we could do that; the Heroult furnace does not figure out 34 pounds; in fact, while making ferro-silicon our electrode charge, as I stated before, was $14 per ton.

In estimating I took a very high labor cost. We are allowing a margin for ourselves in that.

As for the smelter being close to the mine, ours could not be much closer. I do not think it is over two miles away on the hillside.

My estimate of $13.64 was for one furnace, but taking the three furnaces and figuring that the labor would be about the same, would bring it down to below $12.

Mr. Crozier has taken up the freight matter, and I will say nothing except that you can get barges up to Red Bluff. I do not say anything about Redding, and I do not think we have to pay $6.60.

As to iron, we have a very pure ore, so we have no trouble in getting reductions.

The price that I quoted, $5.00 per ton for electricity, is perfectly legitimate figured out on the basis of .31, which I think can be safely arrived at, because I have figured on the basis of charging for the current that we have to pay for and everything from the time the furnace started until it stopped; and as all the runs have been short, and we have only experimented, we have not tried to make all the iron we could. We have tried different things. We tried gas, with which we got bad results; we tried air and had metallurgical troubles; and I do not think it is a bad figure. Those figures are legitimate; I cannot think that of some of the other figures.

Now, Mr. Homburger took me up on the point of power at 50 to 100 times what it cost to generate. I know a few things about what it costs to generate power. I have worked out an extreme case here, but under some circumstances you can make power at 141 times what you can usually get for it. So that you can see that 50 to 100 is not out of the question. And in connection with the $5.00: That is .31 kilowatts per year. So we are actually buying it at $5.00 per ton, because our purchase rate is $16 a kilowatt year. If electric smelting is to be done, you have to get a horsepower at half the price of a ton of coal.

Now, as to the quality of the pig iron: The electric furnace seems to be particularly adapted for removing the impurities, sulphur and phosphorus. We can show analyses made in this city of the pig iron, showing that the sulphur is 11/1000 of one per cent, and the phosphorus 9/1000 of one per cent.

I think that covers about all the points that I noted as the different speakers made them.

The Chairman—Did you answer the question as to the elimination of sulphur?

Mr. Elwell—Yes; the experiment I spoke of with iron pyrites was carried out with a little open crucible furnace, and we all knew there was sulphur around there, and I was considerably surprised that the sulphur contents was only one-tenth of one per cent. I know that the air plays a big part in that. I know this, that Dr. Lindsay said, "I can show you the same thing," and he showed me whole pigs of iron made in a single-phase furnace, in which he claimed there was but 16/1000 of a per cent of sulphur.

Mr. Seaver—That was only in a small crucible.

Mr. Elwell—In my case, but Lindsay turned it out in a commercial way.

A Member—Any open furnace will do that. One or two per cent will make no difference; you can as readily get rid of that as one or two-tenths, which you can readily get rid of in an electrical furnace.

The Chairman—In further elucidation of the elimination of sulphur: If you have a high sulphur content in the ore, the sulphur will unite with the oxygen in the air; the same way with the copper reverberatory furnace. The iron pyrites carrying from six to seven per cent, there is a reduction of the ferric iron to ferrous iron, simply through the action of the sulphur and the high temperature of the electric furnace. That goes on more rapidly, and there is almost an entire elimination of sulphur.

Mr. Seaver—But to reduce that to .1 sulphur is a good deal to do.

The Chairman—Mr. Morgan, can we ask you for anything on the commercial end of this, would you care to do so? We would be very glad to hear from Mr. Morgan, who is the secretary of the Noble Steel Company.

Mr. Morgan—I have no technical knowledge in connection with the matter, but I have had some experience with the reduction of iron ores in California. I was first interested in the subject in 1882. At that time there were three blast furnaces on the Pacific Coast. They were charcoal blast furnaces, one at Clipper Gap, another above Portland, at Oswego, and another at Port Townsend, or near Port Townsend, on the Sound. That was financed by the members of the Union Iron Works and by leading capitalists of San Francisco, and they were all commercial failures, owing to a great variety of causes. To enumerate them, the reason why the blast furnace failed in California was, among other reasons, the giving out of the ore. The ore, which was very promising at one time, at a depth of 200 feet pinched out entirely. But if that ore had continued, the cost of charcoal and the elements necessary to the manufacture would have made it result in failure. The Portland furnace started with an ore running about 40 per cent, and it ran down as low as 30, and gave out at that, and they came down to us to get our Shasta ore. At one time we made a contract with them to take the Shasta ore up to Oregon and smelt it, but the contract was not confirmed by the principals. The manager made the contract, but he was not confirmed by the principals. That furnace has been scrapped. The furnace at Port Townsend was financed by the Contra Costa Water Company, by Mr. Prescott, and by a number of other San Francisco capitalists, and they lost a large amount of money in it. The ore used was very high in sulphur; they had to

pay a duty of forty cents; had to pay transportation on the water across the Sound, and the iron could not have cost them less than $35 or $40 to make. All these furnaces had the disadvantages of producing iron over which there was no control; that is to say, every time the furnace was tapped it produced five grades of iron: Nos. 1 and 2, which were foundry grades; Nos. 3 and 4, which were good for car wheels and certain classes of machinery, and No. 5, white iron. They could sell a limited quantity of part of it and the rest was dead stock; and it was impossible to conduct the business even if other conditions had been favorable. So that these companies all shut down. And then something like ten years ago the Oswego furnace was taken up by people in the East and is now being experimented with, but I think from inherited conditions it is losing money and will not do otherwise. The Shasta Iron Company obtained ownership of the iron mines at the junction of the Pitt and McCloud Rivers about twenty-four years ago, and we have been holding the property, looking for some way in which it could be utilized, and knowing that the charcoal blast furnace was not feasible, knowing that there was no coal on the Pacific Coast which was adaptable for making coke that would carry the burden and be free from impurities. And so we have been looking forward or looking out for what has been termed a direct method of making ore independent of blast furnaces, and I have been brought in contact with a great many inventors and theorists who have put forward a great many schemes, some of them having merit and some not, but nothing has come of it. I had been in correspondence with Mr. Ruthenburg and Mr. Heroult, and we have been anticipating that something could be done electrically. I interested Mr. Noble in the subject, and the correspondence with Dr. Heroult finally resulted in Mr. Noble, personally, putting up a furnace on the Pitt River at a very large expense; and that furnace demonstrated the feasibility of two things; that is, that pig iron could be produced on a commercial scale and that it could be produced by the utilization of the three-phase system, which are two fundamental matters for the carrying on of the business. The furnace, as Mr. Elwell has informed you, has its mechanical drawbacks, and we secured the services of Mr. Lyon, Mr. Clevenger and Mr. Elwell to carry on and develop and overcome the objections to the Heroult furnace. It looks as though they had been successful in most points. They have met certain difficulties which they have had to contend with, but which, I think, now are in a fair way of being cleared up; and I do not anticipate any difficulty in the new furnace which we are about to put in.

In regard to the ores: The ores are of remarkable purity; they run from 68 to 70 per cent. I took samples from the base of the quarry, an open cut of some 40 feet wide and 40 feet deep and some 40 feet in, and sent them to the Colorado Fuel & Iron Company, with whom I was in correspondence, with reference to their drawing their supplies from California, and sending the finished products back to California. They were very much pleased with the ores, but they finally found that the freight rates were prohibitive. But they gave an assay of the ore of 68.1 metallic iron, 2.2 of insoluble, and 18/1000 of phosphorus. Subsequently, Mr. Turnbull took an assay of a pile of ore of 400 tons promiscuously and that was assayed. At first he selected his own ore from the quarry and he sent me back the assay of 68.01 of metallic iron, 2.1 insoluble, and something like .016 of phosphorus. The assays we have had made since then, of ore taken further in, gave 68 and a fraction to 70 per cent of metallic iron and ranging from 9 to 11 thousandths of phosphorus. That shows the character of the ore. This ore crops out at the top of the mine, some 400 feet above our lowest working level, and that ore 400 feet below or not immediately out of the outcrop shows 67 per cent and a fraction of metallic iron. We have also found limestone in the immediate vicinity. We have quarried this iron ore out from this mine at a very low cost. I think it can be quarried out on a considerable scale, by means of power drills, for about 25 cents a ton. I believe the minimum figure at which we can deliver it to the smelter is 25 cents a ton. They call the ore a dollar and a half at the furnace. The rate which we pay the Northern Water & Power Company for power is $12 a horsepower a year, and they are satisfied with that. We have a contract with the Southern Pacific Company to deliver the freight at $2.50 per ton from Redding to San Francisco point. So that it looks to me, while there are some things to be worked out, that the basis of cost is very reasonable, unless iron goes below the present price, which it is at present not likely to do; for the reason that while in China they claim to make pig iron cheap, I have looked into that very carefully, and I do not think, with Chinese labor even at nothing, that they can compete under the conditions on which they have to bring their coal and assemble their ore and pay transportation, and pay duty, with the production of iron on this Coast; and the fact that no Chinese iron has been sold in this market for less than $28 per ton, too, shows either that they are making a very good profit, or they are not able to sell it for less. I think that is about all that I can say. (Applause.)

The Chairman—Mr. Russell, can any of your people here say anything in connection with the furnace at Schenectady, the electrical furnace there?

Mr. Russell—No; Mr. Elwell has just been there and is better informed than any one else.

The Chairman—Mr. Elwell, can you give us any idea of the smelter there?

Mr. Elwell—While East, I naturally wanted to see everything I could of electrical furnaces. The General Electric Company has been experimenting along like lines, but they seem to have kept with the Heroult type of furnace, which they have lined with everything they could think of, and they are lining their furnaces now with carborundum fire sand. They have also experimented with induction furnaces. This furnace is a little different from some of the other furnaces. They are using two primaries, one inside and one outside of their secondary. They are using the regular water-cooled copper pipes. And they have had no trouble with that furnace and have turned out good steel. I think they have also tried the Marcus Ruthenburg process there, but nobody seems very enthusiastic about it. When Ruthenburg came to show the government his process, everything burned up, due, perhaps, to poor management, and he has not shown any result to date.

The Chairman—I still stay with my original remark and I cannot see why it has not been exploited. It is a matter that has some good theoretical points about it and in practice has met with some very hard-shell attacks.

In behalf of the local branch of the American Institute of Electrical Engineers, I wish to thank Mr. Elwell for his paper this evening and for his courtesy in presenting it to us. If there is nothing further we will stand adjourned.

A CORRECTION.

The last paragraph of the article on "Relative Value of Coal and Oil Used As Fuel," by R. F. Chevalier, in our issue of May 2, 1908, should read:

"From the results as above tabulated, we have an evaporation of 122.4 pounds of water per gallon of oil, cost of this gallon being $0.024. An equivalent evaporation required 12.96 pounds of coal, at a cost of $0.023. This places the fuel value of oil at $0.023 per gallon."

NEWS NOTES

FINANCIAL.

New York.—The gross receipts of the United Railroads of San Francisco for June, 1908, show $548,000, an average of $18,200 daily.

Ocean Park, Cal.—August 30 has been named as the date for an election to authorize bonds to the amount of $40,000 for the improvement of the fire department, including the extension of salt and fresh water mains.

San Diego, Cal.—Directors and stockholders of the Del Mar Water, Light & Power Company have voted to issue a $100,000 block of bonds secured by a mortgage on the company's property at Del Mar, for the purpose of making extensive improvements to the plant.

San Francisco.—The ordinance formally inviting offers for the sale to the city of an adequate water-supply system, passed to print at the previous meeting, has been finally passed by the Board of Supervisors. This action is a necessary preliminary to the city's further procedure in acquiring for itself a municipal water system by the development of the Hetch-Hetchy and Tuolumne Valley supply under the plans pending. Chairman Giannini, of the public utilities committee, says that arrangements have been made by that body to visit the Hetch-Hetchy Valley on August 15th, and he has invited the other members of the board and the Mayor, stating that the City Engineer would be in charge of the party. It was agreed that as many members as possible should go, the Mayor also expressing his intention of doing so if other engagements permitted.

Los Angeles, Cal.—After negotiations lasting a week, a New York syndicate's offer for the remaining $20,000,000 worth of bonds of the Owens River water project, issued by the city of Los Angeles, has been accepted by the City Council, and the last financial obstacle to the completion of the city's $23,000,000 plan for a new water supply was surmounted. The syndicate is composed of Kountze Bros. and A. B. Leach & Co., two Wall Street bond houses. The terms of the contract were arranged on the basis of a compromise, the syndicate finally paying more than was at first offered. The purchasers agreed to take $2,040,000 of an issue bearing interest at 4½ per cent at 100¼. Full payment for this issue is to be made by October 15th. Another issue of similar amount and upon similar terms is to be taken in February next and payment completed by June. The syndicate also takes options on the balance of the bonds, which, in effect, it agrees to take at the rate of $816,000 every 60 days, but not more than $5,000,000 in any one year, except the last, when it will take the $6,000,000 remaining. The first two years the premium is to be one-fourth of 1 per cent, the third year one-half of 1 per cent, and the last 1 per cent.

Burlingame, Cal.—Baldwin & Howell have let the last contract for the new Hayward Park tract, Division 111, San Mateo, to the United Gas & Electric Company, which provided for the laying of gas and water mains and sewers and the installation of a complete electric lighting system.

TRANSMISSION.

Red Bluff, Cal.—Dr. Carter, of Tehama, has filed on 10,000 inches of water in Mill Creek. The water is to be used to propel machinery and for general electrical power purposes.

Yuba City, Cal.—The Board of Supervisors has passed an ordinance granting the Great Western Power Company a franchise to string wires over all streets and highways in Sutter County.

Santa Cruz, Cal.—S. Waldo Coleman, manager of the Coast Counties Light and Power Company, who has returned from San Francisco, explains that his corporation is not allied with the Pacific Gas and Electric Company and is not affected by the reported bond transaction and that present prospects here are only for the maintenance of present service, further extensions to wait upon the loosening of the money market.

Yreka, Cal.—The Siskiyou Electric Power Company, with large power plants at Fall Creek and Shasta River, and whose power lines extend all over the county, as well as into Oregon, has been succeeded by the Siskiyou Electric Power and Light Company, capitalized at $1,000,000. In making the change, which is understood to be in name only, the company has also made a change in its schedule of rates for power and light, advancing them about 45 per cent over the old rates, to take effect on August 1st, and all consumers have received notice accordingly.

Santa Rosa, Cal.—It is announced by the engineers in charge that electricity from the generating plant upon Eel River in Mendocino County will reach Santa Rosa on August 1st. The contract calls for it to be here by August 10th. The dam is located on Eel River. From Ukiah the potential line has been built through Hopland, Pieta, Preston, Cloverdale, Geyserville, and is nearing Healdsburg. From Healdsburg it will come on through Windsor and Fulton into Santa Rosa. The current will be used along the line for light and power purposes.

ILLUMINATION.

Monterey, Mexico.—The establishment of a large gas plant is again being agitated here.

Gridley, Cal.—At an election held here July 15th, the citizens voted in favor of issuing $33,000 bonds to provide electric lights and water systems.

Redding, Cal.—An ordinance granting the Northern Light & Power Company the right of erecting poles and stringing wires for the transmission of electric current along the streets and alleys of Redding has been passed.

San Francisco.—The San Francisco Gas and Electric Company has sent the following notice to consumers: "Please be advised that, according to this company's rules, on and after July 1, 1908, there will be rental charge of 50c per month for gas meters of '10-light' size and under when the registration does not exceed 50c, and $1 per month for meters larger than '10-light' size when the monthly registration does not exceed $1." At the offices of the gas company it was stated that the corporation was merely enforcing a rule which it had adopted many years ago.

TELEPHONE & TELEGRAPH.

Bakersfield, Cal.—The Supervisors have granted the city of Los Angeles the right to construct and maintain a telephone line on the desert in this county for a period of five years.

Modesto, Cal.—At a meeting last week a number of farmers of the district lying north of this city formed a Farmers' Telephone Association. J. J. Hardie presided at the meeting and Sam Stuart acted as secretary.

Willows, Cal.—Albert Lindstrom appeared before the Board of Trustees last week and in behalf of the Glenn County Telephone Company petitioned for a 50-year franchise for its telephone line in Willows. The matter was laid over for one week.

Portland, Ore.—The Home Telephone Company will be compelled to furnish what underground cables may be necessary for the fire department if it fails to prove that the terms of the franchise are not sufficiently binding for the city to force it to do so.

San Francisco.—The steamers of the Alaska Steamship Company, the Victoria, Yucatan, Pennsylvania, Santa Clara, and Northwestern, will soon be equipped with wireless systems, and if caught in the ice at any time will be able to be in communication with the world outside of the ice fields. The advantage of wireless telegraph on steamers was clearly shown when the steamship Ohio of the Alaska Steamship Company became icebound last month and for weeks was not heard from. Now the entire fleet of the company's steamers will be equipped with wireless.

Vallejo, Cal.—Instructions have been received at the Mare Island Navy Yard to install on each of the torpedo boats, Goldsborough, Farragut, Perry, and Preble, a 2½-kilowatt wireless telegraph, set before the departure of these vessels on their touring expedition to Honolulu and Guam. The Goldsborough, built on Puget Sound, is expected to arrive at Mare Island in the near future. Wireless instruments for this type of craft have thus far been limited to the microphone receiver for wireless telegraph use and to the more recent development of the wireless telephone. The regular wireless telegraph instruments will prove far more useful and effective. The instruments are coming from the East by express.

POWER AND LIGHT.

Yuba City, Cal.—Miss Elmira J. Wilbur is making arrangements with the Marysville Gas and Electric Company to have a power line strung from her ranch, about three miles west of this city, to the Wilbur ranch in District 70. The power will be used to pump for both irrigation and fire protection.

Mount Vernon, Wash.—N. Aall, of Seattle, electrical engineer of the Skagit Power Company, was in the city recently. During the past eight months Mr. Aall with a corps of engineers has been engaged on preliminary work for his company north of Marblemount. The Skagit Power Company was incorporated for the purpose of harnessing the water power of the Skagit River. The exploitation work of Mr. Aall and his assistants comprehends the probable cost, possibilities, and physical environments and barriers which would result in the development of the Skagit's splendid water power. Mr. Aall says that the utilization of Skagit's water power is not only practicable, but capable of tremendous possibilities. His company plans to develop 75,000 or 100,000 horsepower.

INCORPORATIONS.

Riverside, Cal.—The Alamo Water Company has filed articles of incorporation here.

Los Angeles, Cal.—The Needles Light and Power Company has been incorporated here with a capital stock of $50,000, by W. P. Palmer, W. W. Perry, and M. P. Thye.

Fresno, Cal.—The Point Arena Oil and Development Company has been incorporated here with a capital stock of $100,000, by W. H. Hollenbeck, J. D. Hicks, E. E. Bush, and D. S. Ewing.

Los Angeles, Cal.—The Port Orange Oil Company has been incorporated here with a capital stock of $200,000, by J. M. Kellerman, H. R. Hawkins, S. J. Nash, F. A. Helton and C. N. Van Pelt.

Los Angeles, Cal.—The Glendale Consolidated Water Company has been incorporated here with a capital stock of $1,000,000, by J. A. Pirtoe, F. S. Hutton, M. E. Cary, Hugh Glassell, and D. Griswold.

Los Angeles, Cal.—The Redondo Water Company has been incorporated with a capital stock of $1,000,000. The incorporators are G. C. Ward, Albert Crutcher, G. J. Kuhrts, H. E. Huntington and E. P. Cook.

San Francisco.—The San Mateo Waterworks has filed a certificate of diminution of its capital stock with the county clerk of San Francisco. Formerly the company was capitalized $1,000,000, divided into 10,000 shares of $100 each. Upon the new basis the capital stock is only $10,000, divided into 10,000 shares of $1 each. All the stock has been issued and every stockholder has filed his written consent to the diminution. The directors of the company are Edward McGary, president; L. Foster Young, secretary; Garret W. McEnerney.

ELECTRIC RAILWAYS.

Columbus, Mont.—According to information, active work of surveying the right of way for the electric line from that city to Cooke City will begin from the Columbus end of the route during the present week, a corps of engineers being on the ground for the purpose. H. W. Savage is promoting the enterprise.

Burlington, Wash.—W. A. C. Rowse, president of the Cascade Valley Railroad, who passed through Burlington a few days since, reported that a crew of men has been at work clearing a right of way for this road from Rockport to the Cascade Pass. This road will be operated at first by steam, but eventually by electricity. It will be thirty miles long and will open up a rich mining section. It also means the building of a smelter, possibly at Anacortes.

Bellingham, Wash.—As the franchise and practically all the rights of way along the country roads over which the Bellingham-Blaine-Lynden interurbans are to be built have been secured, surveys are now being made by the company engineers in the city, and there is some speculation as to the route that will be used in coming into the business part of the city. Some of the rights of way inside the city limits have been donated, it is said, and it is probable that before very long an application for a franchise over certain streets will be filed with the City Council.

OIL.

San Francisco.—A restraining order enjoining F. L. Stafford and Sheriff R. R. Veale, of Contra Costa County, from selling at public auction the property of the American Oil and Refining Company was made recently in the United States District Court by Judge Van Fleet. Judgment was obtained against the oil and refining company by Stafford in the State Superior Court and the property was ordered sold by the court in order that the claim of Stafford may be satisfied. The restraining order was asked by several creditors of the oil company on the ground that if the property were sold they would suffer. The petitioners also stated that Stafford's claim should not be preferred over those of several other creditors.

The six new wells that are being drilled by the Graciosa Oil Company are expected to add materially to the output, which is now considerably short of the quantity required to fill existing contracts. The total daily output is about 1,500 barrels and this is turned over to the Japanese, who are now satisfied to get all that is produced, though their original contract called for 7,000 barrels a day. The company's wells were producing more than the quantity required when the contracts were entered into, but the flow decreased later. Local capitalists interested in the business say that it is simply a question of opening more wells until the output is brought up to the amount needed. Later the new model refinery at Oilport may be enabled to operate. The California Petroleum Refineries, Ltd., which owns this refinery, is allied to the Graciosa Oil Company. Additional capital may be secured for further development in the oil fields.

Santa Barbara, Cal.—Property valued at about $150,000 was destroyed as the result of a fire in the Santa Maria oil fields at Orcutt, the principal pumping and shipping station of the Union Oil Company and the Standard Oil Company, recently. Four huge tanks holding 35,000 barrels of oil each were consumed. The fire started presumably from crossed electric wires, which ignited a shack near one of the tanks. Soon the oil was boiling over shack near one of the tanks. Soon the oil was boiling over and explosion followed explosion. The tanks parted at the seams, throwing scalding oil many yards about. For five hours the fire fighters kept the flames confined to the first tank, but soon the burning oil began flowing over and around the other tanks, until four were on fire. The river of burning oil spread to the pumping plant, which was damaged to the extent of $20,000. A tank car on the Pacific Coast Railroad caught fire and the flames spread along the track, the ground being saturated with oil, until ties and bridges were all burned and the rails were warped and broken by the intense heat. The boiling oil soon entered the pipe lines and underground explosions followed. Many thousand barrels of oil in the pipes were destroyed.

WATERWORKS.

San Luis Obispo, Cal.—The bid of Manuel J. Simas for a franchise to furnish water at Avila has been accepted.

Vallejo, Cal.—Superintendent of Streets Savage has asked for the purchase of five fire hydrants and 2,360 feet of ¾-inch water pipe.

Burlingame, Cal.—Specifications for water pipe for Dingee Park have been adopted, and the clerk has been ordered to advertise for bids.

San Bernardino, Cal.—The city is considering the purchase of 525 acres of water-bearing land, comprising the Ferguson ranch. It is so situated that water developed thereon can be conveyed by gravity to the city reservoir and supplied to distribution system without need of artificial pressure.

Mill Valley, Cal.—A tremendous engineering feat will soon be begun by the Lagunitas Water Company, in an effort to outwit the Marin County Water Company. This means the construction of a dam 110 feet high by the company, of which Frederick Paxson Howard is president, impounding in a reservoir 100 feet deep and 7 miles in circumference 2,000,000,000 gallons of water to furnish a flow of 10,000,000 gallons for San Rafael and other towns, to be supplied through an 8,000-foot tunnel.

San Francisco.—Charles Webb Howard, for thirty years president of the Spring Valley Waters Works, and a resident of California since 1852, died at his residence in San Rafael, a few days ago, at the age of 77 years and 6 months. A hemorrhage of the brain terminated an illness which had afflicted the deceased since prior to the time of the San Francisco fire. A year before that time, in June, 1905, Howard retired from the water industry, disposing of his interests in the old Spring Valley Water Works to the promoters of the new company.

TRANSPORTATION.

Pasadena, Cal.—The City Council has ordered advertisements for the sale of a franchise, for General Manager McMillan, of the Pacific Electric Company, for an electric line on East California Street from Lake Avenue to the eastern boundary.

Santa Ana, Cal.—A right of way with the exception of one piece of property has been secured by the California Sugar Company for an electric line from the freight yards of the Pacific Electric on East Fourth Street to the factory site on South Main Street, two miles south of this city.

Santa Barbara, Cal.—At a recent meeting of the Supervisors the franchise granted to the Merchants' Mutual Light and Power Company in September, 1906, to build and operate an electric line to Goleta, was revoked and the way left open to any other company to secure a right to build the line.

San Francisco.—More than twenty petitions, bearing the names of more than 1,000 commercial organizations, banks, hotels, business houses, and individuals, calling on the Board of Supervisors to permit the operation of cars by electricity on the outer tracks on Market Street, without the imposition of conditions recently named, have been filed with the clerk of that body.

San Francisco.—The Fillmore Street Improvement Association petitioned the Board of Supervisors recently to ask bids for a street railway franchise for double tracks in Gough Street from McAllister to Market. Such a route would afford an easy gradient from Fillmore via McAllister, Gough and Valencia to the Mission. It would avoid the steep grades in Fillmore south of McAllister, but would isolate a large section should the majority of the present Fillmore-Mission cars be sent over it.

Colton, Cal.—The City Council is considering doubling the capacity of the municipal lighting system, and as soon as the cost is ascertained, orders for the work probably will be issued.

ELECTRIC RAILWAYS.

Portland, Ore.—The Portland Railway, Light & Power Company has been granted a permit to erect a one-story brick car barn on Savier, between Twenty-third and Twenty-fourth, to cost $9,000.

Vancouver, B. C.—Bids will be received up to July 23 for the clearing, grading, etc., of the second section, 26 miles, Cloverdale to Abbottsford, Westminster-Chilliwack Railway. Charles Garden, C. E., B. C. Electric Railway, Vancouver, will receive the bids.

Grants Pass, Ore.—Glenville Collins, a civil engineer of Seattle and representing Seattle capital, has moved with his family to this city and has taken up the preliminary plans for an electric railway from Grants Pass to the Illinois Valley, western Josephine County. He will petition the County Commissioners and the City Council for a franchise. The line will be surveyed in the near future.

Phillipsburg, Mont.—Within two years freight and passenger trains will be lifted over the Bitter Root Mountains on the backbone of the continent and dropped into the Inland Empire of the Northwest by electric power. The Chicago, Milwaukee & St. Paul Railroad is harnessing the "swift waters" of the St. Joe River for electrification of the Idaho and Eastern Washington division of its new transcontinental line.

Seattle, Wash.—An extension of the Beacon Hill car line along the city pipe line to Rainier Beach, five miles distant, to tap territory now reached only by the Seattle, Renton & Southern Railway, is projected by the Seattle Electric Company, according to the statement which Manager F. E. Potter made a few days ago to Councilman W. M. Hines, of the Twelfth Ward, F. W. Blair, J. R. Roberts, G. S. Deming and other residents of South Beacon Hill.

Vancouver, B. C.—The B. C. Electric Railway Company has issued a call for tenders for the grading of the right of way for the second section of the tram line between New Westminster and Chilliwack. This covers a stretch of 26 miles according to the route outlined, extending from Cloverdale, the end of the section, to Abbottsford. The tenders are to be in by July 23, and it is expected to press operations vigorously so soon as the contract is awarded.

North Yakima, Wash.—George S. Rankin, managing director of the Yakima Valley Transportation Company, has returned from his trip to New York, where he went for the purpose of financing the extension of the electric railway system into Moxee, Ahtanum, and Sunnyside Valleys, and has submitted to the trustees a satisfactory plan for the undertaking. The system will embrace about 100 miles of railway and permit of yet further extension in the near future.

Waterville, Wash.—James Fullerton, of Seattle, appeared before the County Commissioners here recently in behalf of his electric line franchise, which he proposes to run from a point on the Columbia up the Grand Coulee, with a branch to Waterville. The franchise was not granted at this time on account of some defects in publishing the notices. Mr. Fullerton said he had secured the right of way the entire length of the line with the exception of three farmers, who were holding out, and that he did not want to deal with them until after the franchise had been granted.

POWER AND LIGHT.

Cooke, Mont.—H. W. Gilles, general manager of the New World Reduction & Power Company, and Messrs. Thomas Hamilton, Samuel Rayner, R. G. Reinsdorff, and G. W. Hohlefop, all of Seattle, Wash., arrived in town recently and have started to make arrangements to put the power plant and sawmill in operation at the falls on the Clark's Fork.

Portland, Ore.—The contract was let by the Portland Railway, Light & Power Company for the building of an underground system of conduits and cables in the business district, as required by city ordinances. The contract amounts to over $1,000,000, and was awarded to the engineering firm of William S. Barstow & Co., of New York. This firm also has offices in Portland in charge of William S. Turner.

Nelson, B. C.—A final rupture has occurred between the city and the installing company of the municipal power plant, which is supplying power for electricity for lighting the streets and houses, and operating various industries, tramway, etc. The Allis-Chalmers-Bullock Company, after two years, have now declared that they are unable to supply a governor up to the city's requirements and the municipality will now finish the plant by putting in a governor purchased directly by themselves.

Miles City, Mont.—To utilize a portion of the vast power of the Yellowstone River for the purpose of developing electric power, to be supplied to all localities along the Yellowstone River within practicable distance, is the plan formed by George Burt, the former owner of the Burt tract of 60,000 acres of eastern Montana land, and now a capitalist, with a knowledge of practical mechanics. By an engineer's reconnoissance, Mr. Burt has ascertained that a dam across the river sufficient for the purpose can be built for about $200,000, and a suitable ditch will be made parallel to the river, and the fall from the waters of this ditch back to the river will supply the power desired. Mr. Burt will organize a company with this end in view.

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